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JOURNAL OF PALEONTOLOGY

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CONTENTS

Upper Cambrian trilobites from the Lévis conglomerate ..... *Franco Rasetti* 229

New tabulate corals from the Pennsylvanian of Texas ..... *John W. Wells* 259

The Hull bryozoan *Escharopora hogbeni* ..... *Madeleine A. Fritz* 263

A rhinoceros tooth from the Clarno Eocene of Oregon ..... *R. A. Stirton* 265

Halysites gracilis from the Ordovician of Manitoba ..... *E. I. Leith* 268

An *Amebelodon* from Malheur County, Oregon ..... *John Andrew Wilson* 271

Proloculus in Foraminifera ..... *Hubert G. Schenck* 275

South American and European species of *Spondylospira*. *H. E. Vokes and Otto Haas* 283

Check list of the fossil reptiles of New Jersey ..... *William F. Rapp, Jr.* 285

PALEONTOLOGICAL NOTES

"Upper Albian ammonite from . . . New Mexico" a Turonian *Prionocyclus* ..... *Otto Haas* 289

SOCIETY RECORDS AND ACTIVITIES

Officers, correspondents, fellows, and members of The Paleontological Society 290

Nominations for offices in The Paleontological Society 300

Changes of address 300

EDITORS

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UPPER CAMBRIAN TRILOBITES FROM THE LÉVIS CONGLOMERATE

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ABSTRACT—The Lower Ordovician Lévis formation, exposed at Lévis, Province of Quebec, partly consists of limestone conglomerate containing boulders of Lower Cambrian, Upper Cambrian and Lower Ordovician age. The Upper Cambrian boulders contain a rich fauna consisting mostly of trilobites, all of which are discussed and illustrated in the present paper. This trilobite fauna contains 96 species, 45 of which are new. Ten new genera are also established. By far the greatest majority of these Upper Cambrian trilobites belong to the *Hungaia magnifica* faunal zone, which is equivalent to the Gorge formation of northwestern Vermont and probably is of late Trempealeau age. A few boulders, however, contain a peculiar fauna which suggests that they represent strata of early Upper Cambrian age.

INTRODUCTION

THE LÉVIS formation, exposed in the vicinity of Lévis, Province of Quebec, consists of shale, thin-bedded limestone and limestone comglomerate, and is of Lower Ordovician age. Owing to its complicated structure, the stratigraphic sequence within the formation has only been worked out for limited portions (Logan, 1863; Clark, 1926).

The rich fossiliferous content of the Lévis rocks attracted the attention of the early students of the "Quebec group." While Hall illustrated the celebrated graptolite fauna of the black shales, Billings (1865) described the faunas of the limestone conglomerate. As it is well known, disagreement prevailed for a long time among stratigraphers and paleontologists concerning the age of these faunas, and in particular of the trilobites occurring in the limestone. Part of the confusion, at least, was due to the fact that while both Logan and Billings were perfectly aware of the conglomeratic character of the beds, they never seriously considered the hypothesis that the age of at least part of the fossils might be older than the age of the Lévis formation.

A clear understanding of the situation was first brought about by the work of Walcott (1890). As a result of his investigations, we now know that the fossils in the limestone occur in: (1), Lower Cambrian boulders, containing olenellids, *Salterella*, etc.; (2), Upper Cambrian boulders, containing a rich trilobite fauna; (3), boulders of early Canadian age, with *Lloydia*, *Leiostegium*, *Pilekia*, etc.; (4), thin-bedded limestones belonging to the Upper Canadian Lévis formation, characterized by *Shumardia granulosa*.

Clark (1924), in a comprehensive study of the paleontology of the Lévis formation, was the first to assign all the described species to the different faunal zones. Nearly all his conclusions are correct. He also described a

considerable number of new species, most of the trilobites belonging to the Upper Cambrian fauna.

The writer has been collecting from the limestone conglomerate of the Lévis formation for three years, and a large trilobite fauna has been brought to light. Attempts to identify the fossils led to the conclusion that many of the species had not been sufficiently well described and illustrated to make their identification certain. Moreover, most of Billings' species still waited to be placed in their proper generic position.

For these reasons, it was clear that the mere description of new species would hardly contribute to the understanding of these faunas, unless all the described forms were also restudied and illustrated. Consequently, the writer examined and photographed all of Billings' types. With casts of Clark's type specimens, as well as casts of all the species described by Raymond from the Upper Cambrian and the Lower Ordovician of northwestern Vermont, most of the material required for a revision of the Lévis trilobite faunas was on hand.

The present paper contains the results of the first part of this work, that is, the revision of the fauna of the Upper Cambrian boulders. This faunal zone is usually referred to as the *Hungaia magnifica* zone, from its most striking and characteristic trilobite. The known fauna consists of some 90 species of trilobites, a few gastropods and several brachiopods, which have recently been revised by Ulrich and Cooper (1935). All of the trilobites are discussed and illustrated in the present paper.

ACKNOWLEDGMENTS

The late Dr. Charles E. Resser of the United States National Museum supplied the writer with casts of Raymond's and Clark's types. By this invaluable contribution, as well as by his constant advice and encouragement, he made this work possible, and the author wishes to acknowledge his deepest indebtedness to him. The writer is also indebted to the Geological Survey of Canada for being permitted to study and photograph Billings' types, and in particular to Dr. Alice E. Wilson, Paleontologist of the Survey, for her most valuable help.

OCCURRENCE OF THE FOSSILS

Boulders containing Upper Cambrian fossils are scattered throughout the Lévis conglomerate, but only at a few localities do they occur in sufficient numbers and size to make collecting worth while. One of the most fossiliferous localities, from which the early collectors of the Geological Survey of Canada obtained most of their material, is the hill designated by Logan (1863) as North Ridge, where the conglomerate bands numbered by Logan as 1, 2, 3 and 4 crop out just northwest of the Catholic cemetery. Another fossiliferous locality is the one indicated on Logan's map as Guay's quarry, situated on the hill just behind St. Joseph's church. At that place, a boulder of unusually large dimensions (some 40 feet across) crops out. The boulder consists of light-grey Upper Cambrian limestone, and probably is what Marcou called the "Redoubt limestone." Other Upper Cambrian boulders occur on Middle Ridge, probably in Logan's conglomerate band 6. Highly fossiliferous boulders are relatively abundant between Middle Ridge and South Ridge, in an isolated outcrop of a conglomerate band which Logan was unable to place stratigraphically, and which is designated on his map as B^3.

The author has taken great care to label the fossils according to the boulder from which they were collected. This serves the double purpose of determining associations of species, which may lead to a subdivision of the fauna, and also of helping to assign pygidia to their respective cranidia. Whole specimens of trilobites are exceedingly rare in these limestones, and pygidia usually have to be attributed by association.

A list of boulders with their respective faunas will be given in a later section of this paper.

Lithologically, the Upper Cambrian boulders usually consist of pure, fine-grained limestone ranging in color from light to dark gray, the latter often assuming a purplish hue. Quartz sand may occur in these limestones, and in a few instances its percentage is so high that the rock might rather be designated as a calcareous sandstone.

The peculiar problems connected with the origin of the Lévis conglomerate have most recently been discussed by Bailey, Collet and Field (1928).

AGE OF THE FAUNA

Since the Upper Cambrian fossils at Lévis occur only in conglomerate boulders, the stratigraphic position of each species can only be ascertained either by association with other species of known age or by its occurrence in regularly bedded rocks at other localities.

The first question that presents itself is whether the Upper Cambrian trilobites from Lévos belong to one or more faunas. An examination of the list of species collected from each boulder, as given at the end of this section, shows that by far the greatest majority of the boulders contain essentially the same faunal assemblage, although many of the actual species differ from one boulder to another. This assemblage is the *Hungaia magnifica* fauna. There are, to be sure, a few species described by Billings which the writer has been unable to find, and whose association is not known. Nevertheless, the character of almost all of these trilobites leaves little doubt that they, too, belong to the *Hungaia* fauna.

The present revision of the fauna of the *Hungaia* zone further emphasizes its equivalence with the Gorge formation of Vermont, an equivalence which was pointed out by Clark (1924) and by Raymond (1924). After a revision of a few generic assignments among Raymond's species from the Gorge, the list of trilobite genera common to the Gorge and the *Hungaia* zone at Lévis is the following:

Acheilus	*Loganellus*
Agnostus	*Onchonotus*
Ambonolium	*Platycolpus*
Apatokephaloides	*Plethometopus*
Aposolenopleura	*Pseudagnostus*
Bienvillia	*Richardsonella*
Heterocaryon	*Saukiella*
Keithia	*Stenopilus*
Keithiella	*Tatonaspis*
Lecanopyge	*Zacompsus*
Litagnostus	

This represents 21 genera, or about half of those occurring at Lévis.

The problem is not simple when we try to place the *Hungaia* zone and the Gorge in the standard St. Croixan sequence of the Upper Mississippi valley. We may immediately exclude the Dresbach and the lower third of the Franconia as possible equivalents, since there is not a single genus in common. However, starting with the *Ptychaspis* zone of the middle Franconia and throughout the remaining zones of the Franconia and all of the Trempealeau, we find scattered here and there some of the genera that occur at Lévis, but nowhere do we encounter a faunal assemblage whose equivalence with the *Hungaia* fauna appears obvious. Of the Lévis genera, *Litagnostus* and *Pseudagnostus* occur in the middle Franconia; *Platycolpus*, *Plethometopus* and *Stenopilus* are typical of the Trempealeau. Resser inclined toward the view that the *Hungaia* fauna is of late Trempealeau age. This conclusion is supported by the fact that two of the genera, *Loganopeltis* and *Onchonotus*, also occur in the lower Canadian.

A few of the Upper Cambrian trilobites from Lévis do not seem to belong to the *Hungaia* zone, but rather to a lower stratigraphic level. Among the boulders collected by the writer, no. 51 contains trilobites belonging to three new genera, *Onchopeltis*, *Pterocephalops* and *Quebecaspis*, which according to Resser, seem to present early Upper Cambrian affinities. Among the species described by Billings, *Pseudolisania hisingeri* may be assumed to be another fossil of early Upper Cambrian age. Although the evidence is not decisive, these findings point toward the existence, in the Lévis conglomerates, of boulders representing strata of Dresbach age. There is no proof yet that all the above-mentioned species belong to one faunal zone. However, it will be tentatively assumed that they do, and the stratigraphic level which they represent will be designated, at least provisionally, as the *Pseudolisania* zone.

Of the genera occurring in the *Hungaia* zone at Lévis, probably the most common are *Acheilus*, *Onchonotus*, *Platycolpus*, *Plethometopus* and *Stenopilus*. It is a remarkable fact that most of these common trilobites are smooth forms and belong to species of small size, as already noticed by Raymond concerning the fauna of the Gorge.

FAUNAL LISTS OF BOULDERS

A list of the boulders according to the localities at which they were collected follows.

North Ridge, conglomerate band 4: boul-

TABLE 1. FAUNAL ASSOCIATIONS IN THE UPPER CAMBRIAN BOULDERS

Boulder	1	12	14	15	32	36	37	38	39	40	41	42	43	44	45	51	52	56
Acheilus marcoui									×									
Acheilus latus					×													
Acheilus brevis								×										
Acheilus microps							×											
Acheilus depressus																	×	
Acheilus communis		×		×			×											
Acheilus limbatus				×														
Acheilus gibbus					×													
Agnostus americanus				×			×											
Agnostus orion	×			×														
Ambonolium affine					×													
Apatokephaloides pauper						×		×	×									
Aposolenopleura dunbari	×			×		×	×											
Aposolenopleura carinata								×										
Aposolenopleura platyfrons																	×	
Aposolenopleura? brevifrons				×														
Bayfieldia tumifrons								×										
Bienvillia corax				×		×	×	×										
Calymenidius tuberculatus				×														
Heterocaryon tuberculatum						×												
Hungaia magnifica	×					×	×	×										
Hungaia quadrispinosa				×														
Keithia subclavata						×	×	×	×			×						×
Keithia similis					×													
Keithiella cylindrica					×	×	×	×										
Keithiella depressa														×				
Keithiella brevis					×													
Lauzonella planifrons						×												
Lauzonella broeggeri	×						×											
Lecanopyge expansa													×					
Lecanopyge prolifica										×								
Lecanopyge angustata										×								
Lecanopyge? intermedia												×						
Lecanopyge? arenaria															×			
Lecanopyge? billingsi								×										
Leiocoryphe occipitalis		×		×			×											
Leiocoryphe? brevis					×													
Levisella oweni						×		×										
Levisella affinis							×											
Levisella brevifrons				×														
Litagnostus levisensis						×												
Loganellus similis				×														
Loganellus belli						×												
Loganellus macropleurus				×														
Loganellus? duplicatus										×								
Loganellus? unisulcatus																		×
Loganopeltis senkeri	×				×	×		×		×								
Loganopeltis minuta		×																
Onchonotus globosus								×										×
Onchonotus richardsoni	×			×			×			×								
Onchonotus nasutus						×		×										×
Onchonotus granulatus								×										
Onchonotus convexus					×													
Onchopeltis spectabilis																×		
Platycolpus capax					×			×										
Platycolpus dubius						×												
Platycolpus depressus														×				
Platydiamesus levisensis									×									
Plethometopus acutus			×											×				
Plethometopus convergens					×													
Pseudagnostus canadensis	×	×		×		×		×										
Pseudagnostus gyps				×		×	×	×										

TABLE 1. FAUNAL ASSOCIATIONS IN THE UPPER CAMBRIAN BOULDERS—*continued*

Boulder	1	12	14	15	32	36	37	38	39	40	41	42	43	44	45	51	51	56
Pseudosaukia brevifrons			×															
Pterocephalops acrophthalma																×		
Quebecaspis breviceps																×		
Raymondina respecta							×	×										
Richardsonella megalops						×												
Richardsonella elongata	×																	
Richardsonella unisulcata				×														
Richardsonella cristata						×												
Richardsonella convexa						×												
Stenopilus intermedius								×				×						
Stenopilus dubius					×													
Stenopilus pronus										×								
Stenopilus elongatus					×													
Stigmametopus levisensis								×										
Talbotina? levisensis											×							
Tatonaspis levisensis						×												
Zacompsus? levisensis				×														

ders 1, 12, 15, 36–38, 56; conglomerate band 2 (?): boulder 39.

Guay's quarry, conglomerate band 4 (?): boulder 32.

Middle Ridge, conglomerate band 6 (?): boulder 51.

South Ridge, conglomerate band B^3: boulders 14, 40, 41–45, 52.

In the accompanying table, all the species collected by the author are listed and their presence in the different boulders is indicated.

SYSTEMATIC DESCRIPTIONS

Order AGNOSTIA

Genus AGNOSTUS Brongniart, 1822

AGNOSTUS AMERICANUS Billings

Plate 36, figures 1, 2

Agnostus americanus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 302, figs. 1a, b; 1863, Geology of Canada, p. 233, figs. 250a, b; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 395, figs. 372a, b.

This fine species is represented in our collections by a large number of cephala and pygidia. An imperfect enrolled specimen confirms Billings' assignment of the two shields to one species. Billings failed to note the presence of small pygidial spinules.

Holotype (pygidium), Nat. Mus. Canada 859; paratype (cephalon), Nat. Mus. Canada 859c. A cephalon from boulder 37 and the holotype are figured.

AGNOSTUS ORION Billings

Plate 36, figures 3, 4, 7

Agnostus orion BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 304, fig. 2; 1863, Geology of Canada, p. 233, fig. 251; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 397, fig. 373.

Billings based the species on a cephalon. Our boulder 15 contains, besides a number of cephala that are identical with Billings' type, associated pygidia that probably belong to the same species.

The glabella occupies one-third of the width and two-thirds of the length of the cephalon. The anterior lobe has somewhat less than half the length of the posterior lobe, from which it is set off by a straight transverse furrow. The accessory lobes are rather conspicuous. The rim around the cephalon is very narrow.

The pygidium has a strongly convex rhachis extending for about three-quarters of the length. The rhachis is divided into two about equal parts by a transverse furrow, just in front of which is a median tubercle. There are, moreover, two anterolateral lobes separated by oblique furrows. The rim around the pygidium is much wider than that around the cephalon and is set off by a well-impressed furrow. The spines are strong, their length when complete probably exceeding one-third the length of the whole pygidium.

Holotype, Nat. Mus. Canada 860f. The figured cephalon and pygidium are from boulder 15.

AGNOSTUS INNOCENS Clark
Plate 36, figures 14–17

Agnostus innocens CLARK, 1923, Canadian Field Naturalist, vol. 37, p. 122, figs. 7, 7a; 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 17, pl. 3, figs. 3, 3a.

As the available casts did not yield good photographs, Clark's illustrations are reproduced.

Upon examination of casts, it seems doubtful that the *Agnostus* from the Gorge formation that Raymond identified as *A. innocens* belongs to this species.

Holotype, Mus. Comp. Zool. 1697.

AGNOSTUS GLADIATOR Clark
Plate 36, figures 18, 19

Agnostus gladiator CLARK, 1923, Canadian Field Naturalist, vol. 37, p. 124, fig. 10; 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 18, pl. 3, fig. 4.

As the cast of the holotype, an imperfect pygidium, could not be satisfactorily photographed, Clark's illustration is reproduced.

Holotype, Mus. Comp. Zool. 1699.

Genus PSEUDAGNOSTUS Jaekel, 1909

PSEUDAGNOSTUS CANADENSIS (Billings)
Plate 36, figures 8–13

Agnostus canadensis BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 304, fig. 3a, b; 1863, Geology of Canada, p. 233, fig. 252a, b; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 397, figs. 374a, b.

Agnostus janei CLARK, 1923, Canadian Field Naturalist, vol. 37, p. 124, fig. 8; 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 19, pl. 3, fig. 5.

There has been some confusion between this species and the one which Clark described as *Plethagnostus gyps*. Moreover, an examination of Billings' and Clark's types indicates that the cephalon described by Clark as *Agnostus janei* belongs to Billings' *Agnostus canadensis*, and therefore Clark's name should be eliminated. The cephalon that Clark regarded as belonging to *A. canadensis* is the cephalon of his *Plethagnostus gyps*, species which he based on a pygidium. Billings' association of cephalon and pygidium of *A. canadensis* is correct.

The present species is by far the most common agnostid in the Lévis conglomerates, and the finding of cephala and pygidia in the same boulder in about equal numbers confirms Billings' assignment.

Billings failed to notice the pygidial spines, which, although small, are made rather conspicuous by being situated at the widest point of the margin of the pygidium.

Both shields are strongly elevated at the base and become flatter at their distal ends. Near the attachment of the thorax, the sides of the cephalon stand vertically, so that the narrow marginal furrow is not visible from above.

Holotype (pygidium), Nat. Mus. Canada 858b; paratypes, Nat. Mus. Canada 858c-e, h. Besides the types, specimens from boulder 36 are figured.

PSEUDAGNOSTUS GYPS (Clark)
Plate 36, figures 20–22

Plethagnostus gyps CLARK, 1923, Canadian Field Naturalist, vol. 37, p. 124, fig. 9; 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 16, pl. 3, fig. 2.

Pseudagnostus gyps KOBAYASHI, 1939, Tokyo Imp. Univ. Fac. Sci. Jour., sec. 2, vol. 5, pt. 5, p. 158.

The pygidium has been sufficiently described by Clark, except for the fact that he overlooked the existence of exceedingly small spines.

The associated cephalon, in agreement with the pygidium, has a much narrower rim than *P. canadensis*. Moreover, as in the pygidium, the whole area inside of the rim is convex. The glabella is proportionately narrower and longer than in *P. canadensis*. and the small median tubercle is situated somewhat forward of the middle of the glabella. There is a trace of two transglabellar furrows, instead of one as in *P. canadensis*. Both shields are less elevated than in *P. canadensis*.

Holotype, Mus. Comp. Zool. 1700. The specimens figured are from boulders 37 and 38.

Genus LITAGNOSTUS Rasetti, n. gen.

Agnostids with both shields presenting an extremely simple structure. Cephalon without a defined glabella, faintly rimmed. Pygidium without a defined rhachis, with a wider rim than the cephalon. Small median tubercles may be present on either shield.

Genotype, *Litagnostus levisensis*, n. sp.

Remarks.—A few other genera of smooth agnostids have been described, such as *Phalacroma* Corda and *Leiagnostus* Jaekel. However, since they are widely separated geographically and stratigraphically from the species assigned to the present genus, it is highly doubtful whether there is any close relationship.

Besides the genotype, *Agnostus parilis* Hall from the Franconia of Wisconsin and *Phalacroma cyclostigma* Raymond from the Gorge are assigned to *Litagnostus*.

LITAGNOSTUS LEVISENSIS Rasetti, n. sp.
Plate 36, figures 5, 6

Cephalon smooth, slightly longer than wide. There is a narrow, faintly delimited rim around the anterior margin.

The pygidium has a wider, better-defined rim, which widens toward the posterior end. There is a small median tubercle, situated somewhat in advance of the midpoint.

This species may be identical with the one from the Gorge which Raymond identified as *Phalacroma parilis* (Hall).

Syntypes, Laval Univ. 1103a, b. Locality, boulder 36, North Ridge.

MISCELLANEOUS TRILOBITES

Owing to the unsatisfactory status of the systematics of groups of Cambrian trilobites of higher than generic rank, all genera exclusive of the agnostids will be arranged alphabetically.

Genus ACHEILUS Raymond, 1924

Species of *Acheilus* are among the most common and typical fossils in the Upper Cambrian boulders at Lévis. The discovery of several new species gives a better understanding of the limits of variability of the genus.

The glabella may slightly expand toward the front (*A. marcoui*, *A. latus*, *A. brevis*), or be parallel-sided (*A. depressus*, *A. microps*), or even taper slightly (*A. communis*, *A. limbatus*). In the species of the first group, the anterior fixigenes are extremely reduced, and the palpebral lobes relatively large, prominent and close to the glabella. The species of the second group have short, narrow palpebral lobes more anterior in position and more distant from the glabella; the posterior fixigenes are considerably wider than in the species of the first group. The species of the third group are characterized by the presence of relatively wide anterior fixigenes. In these species, moreover, the dorsal furrows become obsolete before reaching the front margin of the cranidium, and the obliteration of the brim is not quite complete as in the other species of the genus. There is, however, no furrow or any appreciable change in slope to set off the glabella from the brim.

Notwithstanding these differences, the species of *Acheilus* constitute a natural assemblage of forms. The most constant common character is the shape of the posterior glabellar furrows, which are always sharply bent backward before crossing one-third of the glabellar width. Another common character is the presence of surface ornamentation.

ACHEILUS MARCOUI Raymond
Plate 36, figures 31–35

Acheilus marcoui RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 422, pl. 13, fig. 15.

Glabella expanding toward the front, rather sharply turned downward in the anterior third. Dorsal furrows of uniform depth extending to the anterior margin. Three pairs of glabellar furrows visible in the larger specimens. Anterior fixigenes extremely narrow; posterolateral limbs narrow, curving backward. Librogenes narrow, with a striated margin and stout, short genal spines.

The pygidium that occurs associated with the cranidia of this species has a remarkable structure. The axis consists of a first segment bearing a small tubercle and of a fused terminal section elevated into a large, compressed spine. One furrow crosses the axis, and two more are faintly impressed on the sides of the spine-bearing section. Pleural lobes narrow, with both furrows and grooves impressed.

Holotype, Mus. Comp. Zool. 1734. All the figured specimens are from boulder 39, North Ridge.

ACHEILUS LATUS Rasetti, n. sp.
Plate 36, figures 23, 24

Similar to *A. marcoui*, from which it dif-

fers mainly because the glabella is proportionately wider and less convex in both directions. Glabella expanding toward the front; dorsal furrows extending to the anterior margin. Glabellar furrows much less distinct than in *A. marcoui* posterior pair more anteriorly situated than in that species. Surface covered with low pustules. Length of largest cranidia 3 mm.

Syntypes, Laval Univ. 1106a, b. Abundant in boulder 32, Guay's quarry.

ACHEILUS BREVIS Rasetti, n. sp.
Plate 36, figures 36, 37

In this species, the glabella has a quadrate form, the width exactly equaling the length exclusive of the occipital segment. Only in the anterior third do the dorsal furrows become divergent. Posterior glabellar furrows well impressed, sharply turning backward, almost isolating square basal lobes. Surface rather coarsely granulose. Length of largest cranidia 2.5 mm.

EXPLANATION OF PLATE 36

FIGS. *1, 2—Agnostus americanus* Billings. *1*, Cephalon, ×3; Laval U. 1101. *2*, Pygidium, ×3; N.M.C. 859, holotype. (p. 233)

3, 4, 7—Agnostus orion Billings. *3*, Cephalon, ×5; Laval U. 1102a. *4*, Pygidium, ×5; Laval U. 1102b. *7*, Cephalon, ×3; N.M.C. 860f, holotype. (p. 233)

5, 6—Litagnostus levisensis Rasetti, n. gen., n. sp. *5*, Cephalon, ×5; *6*, pygidium, ×5; Laval U. 1103a, b, syntypes. (p. 235)

8–13—Pseudagnostus canadensis (Billings). *8*, Cephalon, ×3; N.M.C. 858, paratype. *9*, Pygidium, ×3; N.M.C. 858h, paratype. *10, 11*, Cephala, ×5; Laval U. 1104a, b. *12, 13*, Pygidia, ×5; Laval U. 1104c, d. (p. 234)

14–17—Agnostus innocens Clark, ×5. *14, 15*, Top and side views of cephalon. *16, 17*, Top and side views of pygidium. After Clark. (p. 234)

18, 19—Agnostus gladiator Clark. Side and top views of pygidium, ×5. After Clark. (p. 234)

20–22—Pseudagnostus gyps (Clark). *20*, Cephalon, ×5. *21, 22*, Pygidia, ×5; Laval. U. 1105 a–c. (p. 234)

23, 24—Acheilus latus Rasetti, n. sp. Cranidia, ×5; Laval U. 1106a, b, syntypes. (p. 235)

25—Denisia eminens Clark. Cranidium, ×5; M.C.Z. 1713, holotype. (p. 241)

26—Denisia pusilla Clark. Cranidium, ×5. M.C.Z. 1715, holotype. (p. 241)

27—Acheilus depressus Rasetti, n. sp. Cranidium, ×8. Laval U. 1107a, holotype. (p. 237)

28—Acheilus limbatus Rasetti, n. sp. Cranidium, ×5. Laval U. 1108, holotype. (p. 238)

29, 30—Acheilus communis Rasetti, n. sp. *29*, Cranidium, ×5; Laval U. 1109b, paratype. *30*, Cranidium, ×5; Laval U. 1109a, holotype. (p. 237)

31–35—Acheilus marcoui Raymond, ×5. *31*, Libragene. *32, 33*, Top and side views of cranidium. *34, 35*, Top and side views of pygidium. Laval U. 1110a–c. (p. 235)

36, 37—Acheilus brevis Rasetti, n. sp., ×5. *36*, Cranidium; Laval U. 1111 a, holotype. *37*, Pygidium; Laval U. 1111d, paratype. (p. 236)

38—Acheilus levisensis Clark. Cranidium, ×8. After Clark. (p. 238)

39—Acheilus microps Rasetti, n. sp. Cranidium, ×8; Laval U. 1112a, holotype. (p. 237)

40, 41—Acheilus gibbus Rasetti, n. sp., ×5. Top and side views of cranidium; Laval U. 1113, holotype. (p. 238)

42, 43—Apatokephaloides pauper (Billings). *42*, Cranidium, ×2; N.M.C. 877b, holotype. *43*, Cranidium, ×2; Laval U. 1114. (p. 238)

44, 45—Aposolenopleura dunbari Raymond. Cranidia, ×5; Laval U. 1115a, b. (p. 239)

46—Aposolenopleura? brevifrons Rasetti, n. sp. Cranidium, ×5; Laval U. 1116a, holotype. (p. 239)

47—Aposolenopleura platyfrons Rasetti, n. sp. Cranidium, ×8; Laval U. 1117 a, holotype. (p. 239)

48—Aposolenopleura carinata Rasetti, n. sp. Cranidium, ×5; Laval U. 1118, holotype. (p. 239)

49, 50—Bayfieldia tumifrons Clark. *49*, Pydigium, ×2; Laval U. 1119. *50*, Cranidium, ×1½; Laval U. 1120, plesiotypes. (p. 239)

51, 52—Bienvillia corax (Billings). *51*. Cranidium, ×3; N.M.C. 876a, holotype. *52*, Cranidium ×3; Laval U. 1121, plesiotype. (p. 240)

53—Glyptometopus laflammei (Clark). Cast of cranidium, ×5; M.C.Z. 1703, holotype. (p. 241)

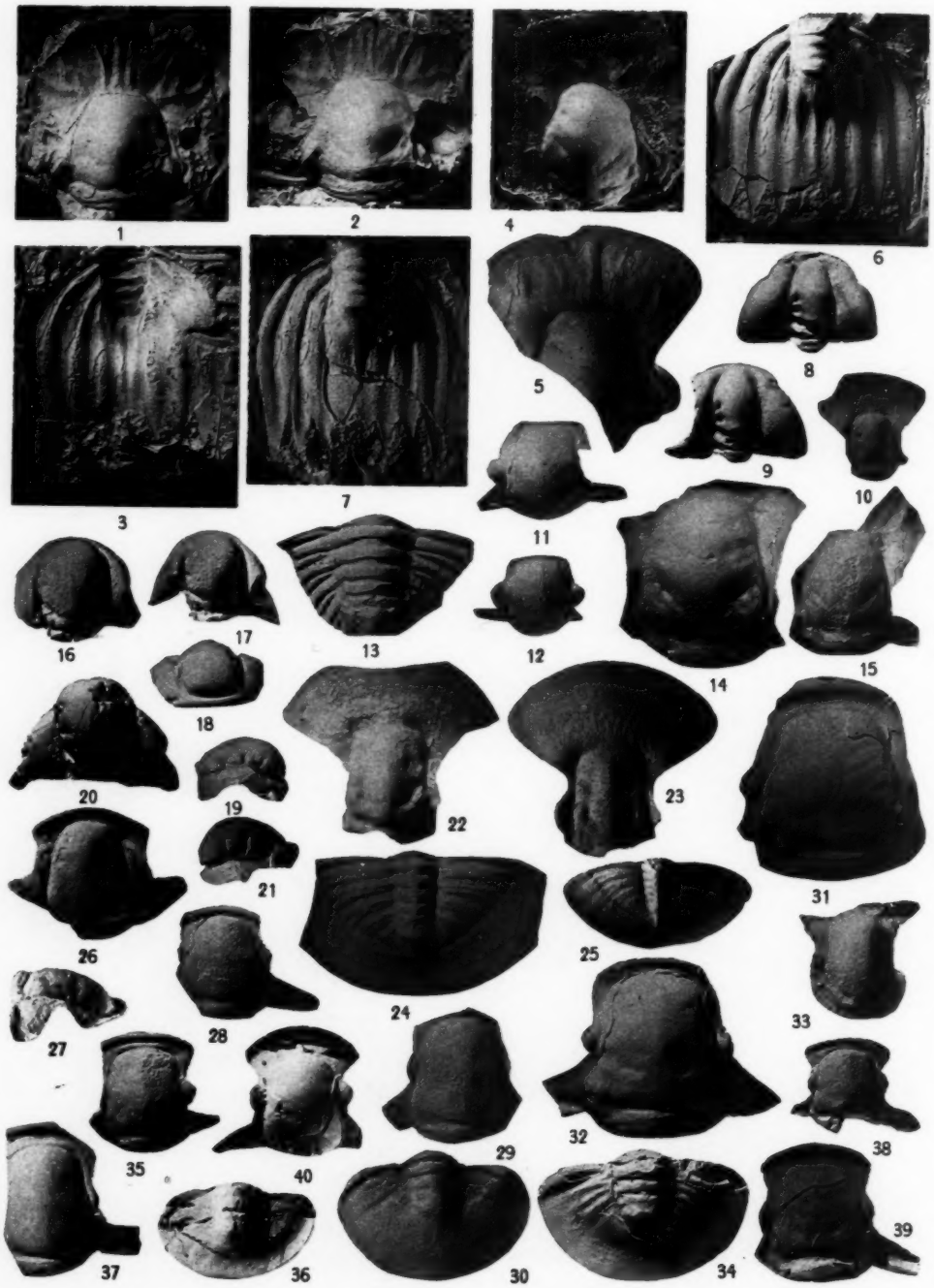
54—Calymenidius tuberculatus Rasetti, n. gen., n. sp. Cranidium, ×5; Laval U. 1122, holotype (p. 241)

55—Heterocaryon tuberculatum Rasetti, n. sp. Cranidium, ×5; Laval U. 1123, holotype. (p. 241)

56—"Menocephalus" sedgwicki Billings. Cranidium, ×4; N.M.C. 885, holotype. (p. 258)

57—Ambonolium affine Rasetti, n. sp. Cranidium, ×1; Laval U. 1124, holotype. (p. 238)

Rasetti, Upper Cambrian Trilobites from Lévis



Rasetti, Upper Cambrian Trilobites from Lévis

An associated pygidium is tentatively assigned to this species. Axis wide, prominent, almost reaching the posterior margin. Pleural lobes narrow, weakly segmented; their anterior outline strongly oblique. Except for the absence of an axial spine, this pygidium is similar to that attributed to *A. marcoui*.

Holotype and paratypes, Laval Univ. 1111a–d. Locality, boulder 38, North Ridge.

ACHEILUS MICROPS Rasetti, n. sp.
Plate 36, figure 39

Glabella parallel-sided, well delimited by the dorsal furrows, proportionately narrower than in any other species. Fixigenes wide, broadly triangular; palpebral lobes small, inconspicuous, situated opposite the anterior pair of glabellar furrows. Two pairs of well-impressed glabellar furrows start from the dorsal furrows and reach about one-fourth of the glabellar width; the furrows of the posterior pair are bent backward. Surface strongly granulated. Length of largest cranidia 2 mm.

Holotype and paratypes, Laval Univ. 1112a-c. Boulder 37, North Ridge.

ACHEILUS DEPRESSUS Rasetti, n. sp.
Plate 36, figure 27

The species is intermediate in shape between *A. microps* and the more typical forms of the genus. The eyes are larger and more posteriorly situated than in the preceding species. Glabella parallel-sided; dorsal and glabellar furrows much shallower than in *A. microps*. Surface rugose. Length of cranidium 2 mm.

Holotype and paratypes, Laval Univ. 1107a-c. Boulder 52, South Ridge.

ACHEILUS COMMUNIS Rasetti, n. sp.
Plate 36, figures 29, 30

This and the following species are not quite typical of the genus, as the brim is not completely eliminated. The dorsal furrows

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EXPLANATION OF PLATE 37

FIGS. *1–3—Hungaia magnifica* (Billings). *1*, Cranidium, ×1½; N.M.C. 848b, holotype. *2*, Cranidium, ×1½; N.M.C. 848c, paratype. *3*, Impression of pygidium, ×1½; N.M.C. 848h, paratype. (p. 242)

4–7—Hungaia quadrispinosa Rasetti, n. sp. *4*, *5*, Cranidia, ×1; Laval U. 1125b, c, paratypes. *6*, Pygidium, ×1; Laval U. 1125a, holotype. *7*, Pygidium, ×2; Laval U. 1125d, paratype. (p. 242)

8, *9—Stigmametopus levisensis* Rasetti, n. gen., n. sp. Cranidia, ×5; Laval U. 1126a, b, syntypes. (p. 257)

10—Lauzonella bröggeri (Clark). Cranidium, ×1½. Laval U. 1127. (p. 244)

11, *12—Tatonaspis levisensis* Rasetti, n. sp. Cranidia, ×2; Laval U. 1128 a, b, syntypes. (p. 257)

13–15—Briscoia? devinei (Billings). *13*, Pygidium, ×1; N.M.C. 869a, Paratype. *14*, Cranidium, ×⅔; N.M.C. 869c, holotype. *15*, Cranidium, ×⅔; N.M.C. 869b, paratype. (p. 240)

16–19—Keithia subclavata (Billings). *16*, *18*, *19*, Top, front, and side views of cranidium, ×1½; N.M.C. 838e, holotype. *17*, Cranidium, ×1½; N.M.C. 838, paratype. (p. 242)

20, *21—Keithia similis* Rasetti, n. sp. *20*, Cranidium, ×2; Laval U. 1129a, holotype. *21*, Side view of another cranidium, ×2; Laval U. 1129b, paratype. (p. 242)

22–25—Lauzonella planifrons (Billings), ×1. *22*, Cranidium; N.M.C. 5594, holotype. *23*, Cranidium; Laval U. 1130a, plesiotype. *24*, Pygidium; N.M.C. 5594a (figured by Billings as *Dikelocephalus* sp. undet.). *25*, Pygidium; Laval U. 1130b, plesiotype. (p. 244)

26, *27—Pseudolisania hisingeri* (Billings). Top and side views of cranidium, ×1; N.M.C. 868a holotype. (p. 252)

28–30—Lecanopyge? arenaria Rasetti, n. sp., ×1. *28*, *29*, Cranidia. *30*, Pygidium; Laval U. 1131a–c, syntypes. (p. 245)

31—Lecanopyge expansa Raymond. Cranidium, ×1; Laval U. 1132. (p. 244)

32–34—Lecanopyge prolifica Rasetti, n. sp., ×1. *32*, Cranidium. *33*, Hypostoma. *34*, Pygidium. Laval U. 1133a–c, syntypes. (p. 244)

35, *36—Lecanopyge? intermedia* Rasetti, n. sp. *35*, Cranidium, ×1½; Laval U. 1134a, holotype. *36*, Pygidium, ×1½; Laval U. 1134b, paratype. (p. 245)

37—Lecanopyge angustata Rasetti, n. sp. Cranidium, ×1; Laval U. 1135, holotype. (p. 245)

38, *39—Lecanopyge? billingsi* (Clark). *38*. Cast of cranidium, ×1½; M.C.Z. 1705, holotype. *39*, Cranidium, ×2½; Laval U. 1136, plesiotype. (p. 245)

40—Platydiamesus? levisensis Rasetti, n. sp. Cranidium, ×2; Laval U. 1137a, holotype. (p. 251)

become obsolete before reaching the anterior margin of the cranidium, and there is a narrow striated brim which, however, is not differentiated from the anterior portion of the glabella either by a furrow or by an appreciable change in slope.

Notwithstanding this important difference, the writer believes that the present species is closely related to the typical forms of *Acheilus* and does not warrant the establishment of a separate genus.

Glabella weakly convex, almost parallel-sided, slightly wider posteriorly. One or two pairs of glabellar furrows are visible; their shape is typical of the genus. Anterior fixigenes wider than in *A. marcoui;* position and size of the palpebral lobes as in that species. Occipital segment strongly swollen in the middle, with a rounded outline. Surface finely rugose. Length of largest cranidia 3 mm.

Holotype and paratypes, Laval Univ. 1109a-d. Locality, boulder 37, North Ridge.

ACHEILUS LIMBATUS Rasetti, n. sp.
Plate 36, figure 28

Extremely similar to the preceding species, from which it differs mainly by the width of the anterior fixigenes, which almost equals one-third of the glabellar width. Surface as in *A. communis*. Length of holotype cranidium 3.5 mm.

Holotype, Laval Univ. 1108. Boulder 15, North Ridge.

ACHEILUS GIBBUS Rasetti, n. sp.
Plate 36, figures 40, 41

This species is remarkable for the strong elevation of the posterior part of the glabella, which rises vertically from the occipital furrow. The glabella slightly expands toward the front. The surface ornamentation consists of transverse irregular ridges on the anterior part of the glabella and of small tubercles on the posterior part. The glabellar furrows are very shallow and not visible from above because of the vertical slope of the sides of the glabella; however, the pattern of the furrows is typical of *Acheilus*. Fixigenes and palpebral lobes as in *A. latus*. Length of holotype cranidium 3.5 mm.

Holotype, Laval Univ. 1113. Boulder 32, Guay's quarry.

ACHEILUS LEVISENSIS Clark
Plate 36, figure 38

Acheilus levisensis CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 25, pl. 3, fig. 12.

It is difficult to evaluate the affinities of such a small trilobite from the cast of an imperfect specimen. It would seem to be closest to *A. communis* and to differ from that species by possessing smaller eyes more distant from the glabella.

Clark's illustration is reproduced. The libragenes seem to have been arbitrarily restored as they are not preserved in the type specimen.

Holotype, Mus. Comp. Zool. 1714. Locality, Middle Ridge.

Genus AMBONOLIUM Raymond, 1924
AMBONOLIUM AFFINE Rasetti, n. sp.
Plate 36, figure 57

There is not much to distinguish this species from the genotype, *A. lioderma* Raymond. The flat tubercles at the posterolateral angles of the glabella are less distinct, and the new species has a larger size.

Holotype, Laval Univ. 1124. Boulder 32, Guay's quarry.

Genus APATOKEPHALOIDES Raymond, 1924

Glabella rather strongly convex, subconical, truncated in front, in some species slightly expanding between the eye lobes. Glabellar furrows represented by two pairs of pits of variable shape. Occipital segment wide. Eye lobes of medium length, narrow, close to the glabella. Anterior facial sutures proceeding straight forward and delimiting very narrow anterior fixigenes. Brim narrow, with a thin, upturned rim.

Raymond compared this genus with *Apatokephalus*. The writer is doubtful about its real affinities and has no first-hand evidence that might either confirm or impair Raymond's tentative assignment of the pygidium.

APATOKEPHALOIDES PAUPER (Billings)
Plate 36, figures 42, 43

Dikelocephalus pauper BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 200.
Ptychaspis? pauper WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 352.

This species is extremely similar to *A.*

inflatus from the Gorge formation. An *Apatokephaloides* reported by Clark from Lévis as *A. inflatus* is probably to be referred to the present species.

The types and most of the other specimens available are exfoliated, but when the test is preserved, the glabella appears to be granulose.

Holotype, Nat. Mus. Canada 877b; paratypes, Nat. Mus. Canada 877a, c-h. Besides the holotype, a specimen from boulder 38, North Ridge is figured.

Genus Aposolenopleura Raymond, 1937

Aposolenopleura dunbari Raymond

Plate 36, figures, 44, 45

Aposolenopleura dunbari Raymond, 1937, Geol. Soc. America Bull., vol. 48, p. 1093, pl. 1, fig. 21.

Specimens from Lévis appear identical with the type from Vermont. Cranidium characterized by a strongly convex glabella with two pairs of short furrows that are faintly impressed on the outer test but somewhat more deeply on exfoliated specimens. Fixigenes rising steeply from the dorsal furrows. Rim thickened, upturned, strongly arched transversely. Palpebral lobes of medium length, narrow, separated from the fixigene by a furrow. Surface granulose.

The figured specimens are from boulder 15, North Ridge.

Aposolenopleura carinata Rasetti, n. sp.

Plate 36, figure 48

Extremely similar to *A. dunbari*, from which it differs mainly because the thickened rim extends backward at the center, thus causing the anterior furrow to meet the dorsal furrow. Glabellar furrows almost indistinct. Surface granulose.

Holotype, Laval Univ. 1118. Boulder 38, North Ridge.

Aposolenopleura platyfrons Rasetti, n. sp.

Plate 36, figure 47

In this species, the fixigenes do not rise from the dorsal furrows as steeply as in *A. dunbari*, but the eye lobes have about the same position and size as in that species. The rim about equals in width the preglabellar area, and instead of being strongly elevated as in *A. dunbari*, is depressed in the middle. Surface smooth. Length of holotype cranidium 3 mm.

Holotype and paratypes, Laval Univ. 1117a-b. Boulder 52, South Ridge.

Aposolenopleura? brevifrons Rasetti, n. sp.

Plate 36, figure 46

This species not quite typical of the genus. The fixigenes are wider and less elevated than in the genotype; moreover, the palpebral lobes are smaller and have a more anterior position. The rim and preglabellar area are much narrower than in *A. dunbari*, but the rim is arched as in that species. Surface almost smooth.

Holotypes and paratypes, Laval Univ. 1116a–c. Boulder 15, North Ridge.

Genus Bayfieldia Clark, 1924

Glabella large, rising high above the fixigenes, slightly conical, truncated in front. Glabellar furrows exceedingly faint. Eyes small, close to the glabella and opposite its midpoint. Anterior facial suture directed straight forward, delimiting a narrow anterior fixigene. Brim narrow, turned up vertically at the center and arched transversely, the anterior angles of the cranidium being strongly bent downward. Neck-furrow deep, occipital segment wide.

Bayfieldia strongly resembles Walcott's genera *Corbinia* and *Eurekia* and may even prove to be identical with the former. Even in that case, since Clark's publication antedates Walcott's by a few months, the name *Bayfieldia* would still be valid and *Corbinia* would become a synonym.

Bayfieldia tumifrons Clark

Plate 36, figures 49, 50

Bayfieldia tumifrons Clark, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 31, pl. 4, fig. 6.

Clark did not notice the upturned brim, which is a characteristic feature of this trilobite, because it is broken off in the holotype specimen. The figured plesiotype shows this feature clearly.

An associated pygidium is tentatively assigned to this species. The pygidium is wide and short, with a strongly elevated axis. Axis with two segments and a terminal sec-

tion which is excavated in the middle, thus forming a pair of protuberances at the sides. Pleura with furrows and grooves, terminating into four pairs of obtuse spines. This pygidium resembles the pygidia of *Corbinia* and *Eurekia*.

Holotype, Mus. Comp. Zoology 1811. The figured specimens are from boulder 38, North Ridge.

Genus BIENVILLIA Clark, 1924

Diatemnus RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, no. 8, p. 1092.

Cranidium depressed, with a subquadrate or suboval glabella defined by a narrow dorsal furrow. Neck furrow and two pairs of glabellar furrows narrow but well defined, of the pattern found in *Triarthrus*. Brim convex, with an exceedingly narrow rim. Eyes small, anterior in position; ocular ridges wide and flat. Anterior facial suture running inward in front of the eye, posterior branch straight, delimiting broad triangular fixigenes.

This cranidium strongly resembles that of *Triarthrus*, from which it differs mainly by the wider brim and shorter palpebral lobes.

Raymond (1937) redescribed the genus as *Diatemnus*. *Diatemnus miculus* is extremely similar to *Bienvillia corax*, differing only by the more quadrate shape of the glabella.

Billings tentatively assigned to *Bienvillia corax* a pygidium which belongs to a species of *Loganopeltis*.

BIENVILLIA CORAX (Billings)
Plate 36, figures 51, 52

Dikelocephalus? corax (part) BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 334, fig. 322a.
Apatokephalus corax BASSLER, 1915, U. S. Nat. Mus. Bull. 92, p. 55.
Bienvillia corax CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 20.

Holotype, Nat. Mus. Canada 876a. Besides the holotype, a cranidium from boulder 36, North Ridge is figured.

Genus BRISCOIA Walcott, 1925
BRISCOIA? DEVINEI (Billings)
Plate 37, figures 13–15

Dikelocephalus devinei BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 195, figs. 180, 181.
Conocephalites devinei MATTHEW, 1893, Royal Soc. Canada Trans., vol. 10, sec. 4, p. 11.
Ptychoparia? devinei WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 350.

This trilobite is unfortunately known only from the fragmentary material available to Billings. Hence its generic position remains uncertain, but what is known does not seem to prevent reference to *Briscoia*.

Of the cranidium, there is hardly anything more than the glabella preserved in the specimens; the extent of the brim and the position and size of the eyes can only be guessed. The posterior glabellar furrows do not unite across the glabella as is usual in *Briscoia*, but the difference does not seem to be important enough to exclude this species from the genus.

The pygidium has a strongly annulated axis and deeply impressed furrows and grooves. The furrows are oblique with respect to the grooves, a character observed in species of *Briscoia*. The furrowed part of the pleural lobes slopes down rather steeply, but the smooth marginal area (broken off in the figured pygidium) is flat or slightly concave.

Holotype (cranidium), Nat. Mus. Canada 869c; paratypes, Nat. Mus. Canada 869, 869a–b.

Genus CALYMENIDIUS Rasetti, n. gen.

Small trilobites known from the cranidium alone. Cranidium wide and short, strongly arched transversely. Glabella defined by narrow and unusually deep dorsal furrows, tapering, truncated in front, with two pairs of deeply impressed glabellar furrows. Posterior furrows starting from the dorsal furrows and curving backward, almost isolating basal lobes; furrows of other pair short. Fixigenes half as wide as the glabella, rising steeply almost to the level of the glabella; posterolateral limbs large, steeply inclined. Eyes small, situated opposite the glabellar midpoint; ocular ridges strong. Facial sutures slightly convergent in front of the eyes. Brim narrow, turned up vertically and arched transversely. Surface tuberculated.

Genotype, *Calymenidius tuberculatus*, Rasetti, n. sp.

Remarks.—The affinities of this trilobite are obscure, as it seems unlikely that the superficial resemblance to *Calymene* may indicate any real affinity. The libragenes are

unknown, but the shape of the cranidium does not suggest proparian sutures.

CALYMENIDIUS TUBERCULATUS
Rasetti, n. sp.
Plate 36, figure 54

The generic description and the illustration present all that is known about this species. The upturned brim was broken off in extracting the specimen from the matrix and does not show on the photograph. Length of cranidium 4 mm.

Holotype, Laval Univ. 1122. Boulder 15, North Ridge.

Genus DENISIA Clark, 1924

It is doubtful whether the differences between *Denisia* and *Acheilus* warrant the recognition of two separate genera. Clark separated Denisia as possessing only one pair of glabellar furrows, a doubtful generic character, especially in a group of trilobites where the glabellar furrows are always faintly impressed. A better distinctive character seems to be the shape of the glabella, which is always more or less straight-sided in *Acheilus*, whereas it has a more rounded shape in Denisia.

DENISIA EMINENS Clark
Plate 36, figure 25

Denisia eminens CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 23, pl. 3, fig. 10.

There is nothing to be added to the original description.

Holotype, Mus. Comp. Zool. 1713.

DENISIA PUSILLA Clark
Plate 36, figure 26

Denisia pusillus CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 24, pl. 3, fig. 11.

The small cranidium that represents the type much resembles *D. eminens*, and possibly may be a young individual of that species.

Holotype, Mus. Comp. Zool. 1715.

Genus GLYPTOMETOPUS Rasetti, n. gen.

Small trilobites known from the cranidium alone. Glabella about as wide as long, strongly convex, tapering, defined by deep dorsal furrows. Two pairs of deep glabellar furrows; furrows of the posterior pair curved, almost isolating basal lobes; other pair short. Fixigenes convex; their width at the palpebral lobes one-third of the glabellar width. Brim narrow, with a narrow convex rim; preglabellar area convex at the sides but depressed in the middle. Palpebral lobes small, situated somewhat forward of the glabellar midpoint; ocular ridges present. Anterior facial sutures almost parallel.

Genotype, *Solenopleura laflammei* Clark.

Remarks.—The shape of the glabella and the character of the glabellar furrows are much the same as in *Calymenidius*, but the other cranidial features are quite different. This is another trilobite whose affinities for the present remain obscure.

GLYPTOMETOPUS LAFLAMMEI (Clark)
Plate 36, figure 53

Solenopleura laflammei CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 26, pl. 3, fig. 7.

Clark's description and the illustration supply all the available information on this species.

An error in the designation of Clark's types is discussed in connection with *Lecanopyge billingsi*.

Holotype, Mus. Comp. Zool. 1703.

Genus HETEROCARYON Raymond, 1937

HETEROCARYON TUBERCULATUM
Rasetti, n. sp.
Plate 36, figure 55

This small trilobite is obviously closely allied to the genotype, *H. platystigma* Raymond. It differs by the narrower brim and the densely tuberculated glabella. Glabellar furrows as in the genotype. Length of cranidium 4 mm.

Holotype, Laval Univ. 1123. Boulder 36, North Ridge.

Genus HUNGAIA Walcott, 1914

The description of this often-quoted genus has never been given.

Cephalon with a well-defined, tapering glabella occupying about two-thirds of the length. Glabellar furrows obscure. Palpebral lobes of medium size, rimmed, close to the glabella and opposite its posterior half. Sutures strongly divergent in front of the eyes, then curving inward. Brim wide, rimless, slightly concave, marked with a few irregu-

lar radial ridges. Posterolateral limbs narrow, parallel-sided. Libragenes wide, flat, faintly rimmed, coalescing in front through a wide doublure; genal spines short. Hypostoma rounded, with a pair of strong impressions in the marginal furrow.

Thoracic segments with a narrow axis and flat, furrowed pleura curving backward, sharply pointed at their ends. The posterior pleura must have enveloped the pygidium.

Pygidium with a prominent, cylindrical, annulated axis occupying one-third of the length, extended into a postaxial ridge. Pleura flat, faintly furrowed, curving backward to assume a longitudinal direction, extended into several pairs of flat spines.

Genotype, *Dikelocephalus magnificus* Billings.

HUNGAIA MAGNIFICA (Billings)
Plate 37, figures 1–3

Dikelocephalus magnificus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 307, fig. 5; 1863, Geology of Canada, p. 235, figs. 255a, b; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 399, fig. 376.
Apatokephalus magnificus BROEGGER, 1897, Nyt Mag. f. Naturvid., vol. 36, p. 175, fig. 10.
Hungaia magnifica WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 351.

Holotype, Nat. Mus. Canada 848b; paratypes, Nat. Mus. Canada 848c, f, h.

HUNGAIA QUADRISPINOSA Rasetti, n. sp.
Plate 37, figures 4–7

Raymond (1924), commenting upon Billings' description of *Hungaia magnifica*, wrote:

> This species is too well known to need redescription, but it should be pointed out that the radial ridges that cross the brim are not so prominent on specimens as the figure would indicate, and that the glabella is proportionately longer and narrower. There is also a rather prominent tubercle on the median line, just in front of the neck-furrow.
>
> The pygidium was incorrectly described and figured by Billings, as there are four instead of three pairs of spines, the inner short ones being left off from Billings' figure, although their presence on the specimen is indicated by the breaks in the smooth curve of the outline of the region between the inner pair of spines there shown.

Examination of Billings' types shows that none of Raymond's remarks apply to them, but that the specimens are correctly represented by Billings' illustrations. Evidently, the individuals upon which Raymond based his remarks were not typical of *Hungaia magnifica*. Such specimens occur abundantly in our boulder 15, and they will be considered as the types of a new species, *H. quadrispinosa*.

The pygidium of the new species, besides showing four well-developed pairs of spines, somewhat differs in outline from that of *H. magnifica*, being proportionately wider posteriorly. The cranidium corresponds to Raymond's description, except that the specimens available to the writer do not show the tubercle in front of the neck furrow. The glabella of *H. quadrispinosa* is narrower and less tapering, besides being less convex in longitudinal section. Moreover, the pair of lateral tubercles opposite the eye lobes is hardly developed. The brim in the new species has a regularly circular outline, whereas it is slightly pointed at the center in *H. magnifica*.

Holotype and paratypes, Laval Univ. 1125a–g. Boulder 15, North Ridge.

Genus KEITHIA Raymond, 1924
KEITHIA SUBCLAVATA (Billings)
Plate 37, figures 16–19

Arionellus subclavatus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 315, fig. 15; 1863, Geology of Canada, p. 237, fig. 265a, b; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 406, fig. 386a.
Keithia subclavata RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 452.

When the test is preserved, the surface of the glabella and fixigenes is covered with low tubercles.

Holotype, Nat. Mus. Canada 838e; paratypes, Nat. Mus. Canada 838, 838a–d.

KEITHIA SIMILIS Rasetti, n. sp.
Plate 37, figures 20, 21

This species is extremely similar to the genotype, *K. schucherti* Raymond, from which it differs only in the more elongate shape of the glabella.

Compared with *K. subclavata*, *K. similis* differs in several characters. In the new species, the glabella attains its maximum width well forward instead of near the middle. Moreover, the glabella overhangs the anterior rim, which is not visible from above, and the posterior glabellar furrows are less oblique than in *K. subclavata*. The surface seems to be smooth.

Holotype and paratypes, Laval Univ. 1129a–d. Boulder 32, Guay's quarry.

Genus KEITHIELLA Rasetti, n. gen.

Known from the cranidium alone. Glabella oblong, parallel-sided; occipital furrow and posterior glabellar furrow continuous across the glabella. Fixigenes rising more or less steeply from the dorsal furrows, thus placing the eyes in a rather elevated position; however, the fixigenes anterior to the eyes are deflected downward. Anterior facial sutures divergent. Rim wide, flat, sloping downward, separated from the fixigenes by the anterior furrow. No preglabellar area. Eyes small; ocular ridges absent. Occipital segment narrow, without spine.

Genotype, *Arionellus cylindricus* Billings.

Remarks.—This genus is closely related to *Ptychaspis*, *Euptychaspis* and *Keithia*. It differs from *Ptychaspis* mainly in the divergence of the anterior sutures and in the more posterior position of the eyes. Both these circumstances contribute to give the new genus wider anterior fixigenes. *Euptychaspis* has a strong occipital spine, a wider rim, and ocular ridges. *Keithia* differs from *Keithiella* in possessing convergent anterior sutures, narrow anterior fixigenes, and a narrow rim. Moreover, in *Keithia* the posterior glabellar furrows do not connect across the glabella, and eye lines are present.

Besides the genotype, two new species and *Ptychaspis affinis* Raymond are assigned to *Keithiella*.

KEITHIELLA CYLINDRICA (Billings)
Plate 39, figures 39–41

Arionellus cylindricus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 314, fig. 14; 1863, Geology of Canada, p. 237, fig. 264; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 406, fig. 385.

Agraulos cylindricus MILLER, 1889, North Am. Geology and Paleontology, p. 527, fig. 955.

It may be added to Billings' description that, when the test is preserved, the prominent parts of the glabella are pustulose.

Holotype and paratype, Nat. Mus. Canada 837a, 837.

Besides the holotype, a cranidium from boulder 32, Guay's quarry, and one from boulder 38, North Ridge are figures.

KEITHIELLA DEPRESSA Rasetti, n. sp.
Plate 39, figure 42

This species is similar to *K. cylindrica* and *K. affinis* but differs in several details. The fixigenes do not rise steeply from the dorsal furrows as in those two species and are somewhat wider. Consequently, the position of the eyes is less elevated and more distant from the glabella. The latter is proportionately slightly wider and shorter. The upper surface of the test is pustulose as in *K. cylindrica*.

Holotype and paratype, Laval Univ. 1166a, b. Boulder 44, South Ridge.

KEITHIELLA BREVIS Rasetti, n. sp.
Plate 39, figure 43

This species differs from *K. cylindrica* and *K. affinis* in possessing a proportionately shorter and wider glabella and narrower anterior fixigenes. The posterior glabellar furrow is deeply impressed across the glabella. The fixigenes rise steeply from the dorsal furrows as in *K. cylindrica*, but the anterior facial sutures are considerably less divergent than in that species. The latter feature brings the present species somewhat close to *Keithia*. The steeply inclined rim is separated from the fixigenes by a well-impressed anterior furrow, as in *K. cylindrica*. Available specimens are exfoliated and the characters of the surface cannot be ascertained. Length of holotype cranidium 5 mm.

Holotype, Laval Univ. 1167. Boulder 32, Guay's quarry.

Genus LAUZONELLA Rasetti, n. gen.

Cranidium depressed. Glabella subrectangular or trapezoidal, with glabellar furrows more or less impressed in the shape of two or three pairs of pits of variable form. Occipital segment wide. Brim almost as wide as the length of the glabella, slightly concave, without rim. Eyes as in *Levisella*. Anterior facial sutures widely divergent, then curving inward and probably remaining intramarginal. Libragenes unrimmed, coalescent through a wide doublure.

Pygidium of the *Levisella* type but with a relatively shorter and narrower axis and a wider smooth marginal area.

Genotype, *Dikelocephalus planifrons* Billings.

Remarks.—This genus is closely allied to *Levisella*, from which it differs in the wider brim, absence of a rim, and more broadly rounded anterior angles of the cranidium.

Besides the genotype, a species described by Clark under the European genus *Dikelokephalina* is placed in *Lauzonella*.

LAUZONELLA PLANIFRONS (Billings)
Plate 37, figures 22–25

Dikelocephalus planifrons BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 309, fig. 6; 1863, Geology of Canada, p. 236, fig. 256; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 401, figs. 377, 383.

Anomocarella? planifrons WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 352.

Holotype (cranidium), Nat. Mus. Canada 5594; paratypes, Nat. Mus. Canada 5594a–d.

Besides the types, a cranidium from boulder 36, North Ridge is figured.

LAUZONELLA BRÖGGERI (Clark)
Plate 37, figure 10

Dikelokephalina bröggeri CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 29, pl. 4, fig. 13.

The short, trapezoidal glabella with furrows represented by short, deep pits gives this species a peculiar aspect.

Holotype, Mus. Comp. Zool. 1708. A specimen from boulder 1, North Ridge is figured.

Genus LECANOPYGE Raymond, 1937

Cranidium with a flat, broad, tapering glabella occupying most of its area. Glabella defined by shallow dorsal furrows; glabellar furrows exceedingly faint or obsolete. Neck furrow shallow, but defined at least in the middle. Eye lobes small, close to the glabella and opposite its midpoint. Anterior facial sutures parallel or slightly divergent. Brim narrow, with an upturned rim that in typical species is not differentiated from the preglabellar area by an anterior furrow. Posterolateral limbs rather large, triangular. Librigenes with genal spines. Hypostoma with a pair of oblique furrows.

Pygidium regularly semicircular, with an axis occupying somewhat more than half the length, rather prominent, faintly segmented. The plural lobes may show a trace of segmentation, but there is always a smooth, partly concave marginal area.

Remarks.—The more complete diagnosis here given is mainly based on the new species *L. prolifica*, known from a large number of fragmentary shields. Other new species from the Lévis conglomerate possess a well-differentiated rim and their cranidia closely resemble some species of *Platycolpus*. It is the writer's impression that the two genera are closely related. Species that possess genal spines and partially concave pygidia have been placed in *Lecanopyge*, while those that present rounded fixigenes and convex pygidia were assigned to *Platycolpus*. From the cranidia alone, a sharp distinction is difficult. Typical species of *Platycolpus* have a wide, flat, striated rim and no preglabellar area, whereas typical species of *Lecanopyge* have an upturned brim without a differentiated rim. There are, however, intermediate species that bridge the gap.

It is possible that *Lecanopyge* is also closely related on one side to *Ambonolium*, on the other to *Platydiamesus*.

LECANOPYGE EXPANSA Raymond
Plate 37, figure 31

Lecanopyge expansa RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1101, pl. 2, figs. 6–8.

One cranidium from Lévis seems to be identical with the type of this species from the Gorge. The Lévis specimen is, however, almost twice as large.

The specimen was collected from boulder 43, South Ridge.

LECANOPYGE PROLIFICA Rasetti, n. sp.
Plate 37, figures 32–34

The cranidium agrees in all respects with that of *L. expansa*, except that it is proportionately narrower, and the glabella is less tapering; the brim is somewhat narrower. The librigenes possess short, rather slender genal spines.

The pygidium has an axis that reaches somewhat more than half the length. The axis is slightly conical, pointed at the extremity, and shows two rings besides a terminal unsegmented section. The pleural lobes show faint furrows and grooves in the proximity of the axis; a wide marginal area is smooth and slightly concave. Test of both

shields finely and sparsely punctate. Length of largest cranidium about 30 mm.

Syntypes, Laval Univ. 1133a–c. Boulder 40, South Ridge.

LECANOPYGE ANGUSTATA Rasetti, n. sp.
Plate 37, figure 37

One cranidium differs from *L. prolifica* in being proportionately narrower. Moreover, the glabella is better defined by the dorsal furrows, and the brim is wider.

Holotype, Laval Univ. 1135. Boulder 40, South Ridge.

LECANOPYGE? INTERMEDIA Rasetti, n. sp.
Plate 37, figures 35, 36

The cranidium of this species possesses a striated rim, differentiated from the narrow preglabellar area by an anterior furrow. The whole cranidium much resembles that of *Platycolpus depressus*, but the libragenes have genal spines.

The pygidium has a concave margin and is typical of *Lecanopyge*. The pleural lobes are practically unfurrowed. Surface of both shields finely punctate.

Holotype and paratypes, Laval Univ. 1134a–c. Boulder 42, South Ridge.

LECANOPYGE? ARENARIA Rasetti, n. sp.
Plate 37, figures 28–30

Many cranidia and pygidia of this species were collected from a boulder of calcareous sandstone.

The cranidium has average convexity, and possesses a narrow raised rim in front of an equally narrow preglabellar area. The fixigenes in front of the eyes are exceedingly narrow, the sutures being parallel.

The pygidium differs from that of *L. prolifica* because the axis is relatively shorter, and the concavity of the pleural lobes is limited to a narrow lateral area. Both the axis and the pleural lobes are more faintly furrowed than in *L. prolifica*. Surface finely and sparsely punctate.

Syntypes, Laval Univ. 1131a–c. Boulder 45, South Ridge.

LECANOPYGE? BILLINGSI (Clark)
Plate 37, figures 38, 39

Loganellus billingsi CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 30, pl. 4, fig. 2.

It must be noticed that Clark's illustration designated with the name of this species should be referred to *Solenopleura laflammei* and vice versa, as it is evident from the descriptions. The same inversion exists in the designation of the holotypes.

The species certainly does not belong to *Loganellus*, and is placed in *Lecanopyge* because of the close similarity to *L. intermedia*, at least as far as the cranidium is concerned.

Compared with *L. intermedia*, the glabella is more convex, the raised rim is stronger, and the anterior sutures are more widely divergent. The surface is more strongly punctate than in any other species of the genus. The pygidium has not been identified.

Holotype, Mus. Comp. Zoology 1705. Besides the type, a specimen from boulder 38, North Ridge is figured.

Genus LEIOCORYPHE Clark, 1924
LEIOCORYPHE GEMMA Clark
Plate 38, figures 1, 2

Leiocoryphe gemma CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 21, pl. 3, fig. 8.

Holotype, Mus. Comp. Zoology 1706.

LEIOCORYPHE OCCIPITALIS Rasetti, n. sp.
Plate 38, figure 4

The cranidia of this species are not rare in some of the Lévis boulders. They resemble some species of *Plethometopus*, but since careful examination failed to reveal any trace of palpebral lobes, the species is placed in *Leiocoryphe*.

The cranidium is wider than long, convex, smooth. The main difference from *L. gemma* consists in the presence of a relatively well impressed occipital furrow. The occipital segment is widened in the middle and has a rounded outline. The largest cranidia are about 3 mm. long.

Holotype and paratypes, Laval Univ. 1139a–c. Boulder 37, North Ridge.

LEIOCORYPHE? BREVIS (Raymond)
Plate 38, figure 3

Stenopilus brevis RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 420, pl. 13, fig. 9.

Cranidia from Lévis appear to be identical with Raymond's type from the Gorge. As stated by Raymond, no trace of the palpe-

bral lobes is visible; consequently, the species is tentatively placed in *Leiocoryphe*. It is difficult to evaluate the affinities of such a featureless cranidium.

The strongly punctate surface is a remarkable character, as all other known species of *Stenopilus* and *Leiocoryphe* are perfectly smooth.

The figured specimen is from boulder 32, Guay's quarry.

Genus LEVISELLA Ulrich, 1930

Cranidium weakly convex. Glabella subrectangular, glabellar furrows weakly impressed or obliterated. Preglabellar area of moderate width. Rim wide, convex, limited by a well-defined anterior furrow that is marked with a series of puncta. Palpebral lobes of medium size, close to the glabella, their centers being located behind its middle point. Anterior facial sutures widely divergent, then curving inward and remaining intramarginal for some distance. Posterolateral limbs narrow, parallel-sided. Libragenes united through the doublure.

The pygidia are extremely similar to the pygidia of *Loganellus*.

Genotype, *Dikelocephalus oweni* Billings.

Remarks.—*Levisella* differs from *Richardsonella* in the smaller size of the eyes, wider rim, and the nonspinose pygidium. It differs from *Loganellus*, with which it is closely allied, by possessing a wider brim and larger eyes that are situated close to the glabella.

Ulrich named the genus in a footnote, but did not give any description.

LEVISELLA OWENI (Billings)
Plate 38, figures 5–7

Dikelocephalus oweni BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 310, fig. 8; 1863, Geology of Canada, p. 236, fig. 259; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 402, fig. 379.

Anomocarella? oweni WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 251.

Richardsonella oweni RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 439.

Levisella oweni ULRICH, 1930, in ULRICH and RESSER, Milwaukee Public Mus. Bull., vol. 12, p. 17, footnote.

Holotype, Nat. Mus. Canada 854; paratypes, Nat. Mus. Canada, 854a–e. Besides the holotype, a cranidium and pygidium from boulder 36, North Ridge are figured.

LEVISELLA AFFINIS (Billings)
Plate 38, figures 8, 9

Dikelocephalus affinis BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 197, fig. 183a.

Platycolpus affinis WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 349.

Levisella affinis ULRICH, 1930, in ULRICH and RESSER, Milwaukee Public Mus. Bull., vol. 12, p. 17, footoote.

The holotype is a very poor weathered specimen, but the other individual illustrated clearly shows the features of the cranidium. *L. affinis* differs from *L. oweni* because the rim at the center is almost twice as wide as the preglabellar area, instead of being equally wide, and is less convex.

The pygidium tentatively attributed to *L. affinis* by Billings belongs to a species of *Platycolpus*.

Holotype, Nat. Mus. Canada 891. The figured plesiotype is from boulder 37, North Ridge.

LEVISELLA BREVIFRONS Rasetti, n. sp.
Plate 38, figures 10–12

This species is readily distinguished from *L. oweni* by possessing a narrower preglabellar area and a narrower and more convex rim. The associated pygidium hardly differs from that of *L. oweni*.

Holotype and paratypes, Laval University 1142a–d. Boulder 15, North Ridge.

Genus LOGANELLUS Devine, 1863

Highgatea RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1087.

Glabella slightly conical, moderately convex, rounded in front. One to three pairs of oblique glabellar furrows not joined in the middle. Preglabellar area always narrow, sometimes absent at the center; rim always present, narrow. Eyes opposite the glabellar midpoint, small, distant from the glabella about one-fifth of the glabellar width; eye ridges faint. Anterior facial sutures widely divergent, straight almost to the anterior margin. Posterolateral limbs narrowly triangular. Libragenes with slender genal spines.

Thorax of 12 segments in genotype. Axis prominent, tapering. Pleura sharply turned backward into spines.

Pygidium short and wide. Axis prominent, conical, with five or six segments, extending

almost to the posterior margin. Pleural lobes with about four pairs of ribs and a smooth, flat or concave marginal area. Surface usually smooth.

Remarks.—*Loganellus* is most closely allied to *Richardsonella* and *Levisella;* their distinctive characters are discussed in connection with the two latter genera. Outside of the genotype, none of the species that have been described as *Loganellus* belong to the genus, but forms described under other genera are good species of *Loganellus.* Some of these have been placed in *Richardsonella*, others were described by Raymond as *Highgatea*. *Highgatea* differs from typical *Loganellus* only by the disappearance of the preglabellar area. This area, however, is exceedingly narrow in most of the species, and there is no sharp limit between species that possess it and species that do not. The pygidia of *Highgatea*, moreover, are typical of *Loganellus*. The author, therefore, will consider *Highgatea* as a synonym. Then *Loganellus* will include, besides the species here discussed, *L. germanus* (Raymond), *L. laeviusculus* (Raymond), and *L. bisinuatus* (Raymond).

LOGANELLUS LOGANI (Devine)
Plate 38, figures 13, 14

Olenus? logani DEVINE, 1863, Canadian Naturalist, vol. 8, p. 95, figs. 1, 2.
Loganellus quebecensis DEVINE, 1863, idem.
Olenus? logani BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 201, figs. 185, 186.
Ptychoparia logani WALCOTT, 1884, U. S. Geol. Survey Bull. 10, p. 36.
Loganellus logani BASSLER, 1915, U. S. Nat. Mus. Bull. 92, p. 754.

There is nothing to add to the original description.

Plastosyntypes, Nat. Mus. Canada 903, 903a. Paratype, Nat. Mus. Canada 886.

LOGANELLUS SIMILIS Rasetti, n. sp.
Plate 38, figures 21–23

This species is extremely similar to *L. logani*, from which it differs in the relatively wider glabella, narrower occipital segment, and more widely divergent anterior facial sutures. The associated pygidium is almost identical with that of *L. logani*.

Holotype and paratypes, Laval Univ. 1145a–d. Boulder 15, North Ridge.

LOGANELLUS BELLI (Billings)
Plate 38, figures 18–20

Dikelocephalus belli BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 311, fig. 7; 1863, Geology of Canada, p. 236, fig. 260; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 403, figs. 378, 382.
Anomocarella belli WALCOTT, 1914, Smithsonian Misc. Coll., no. 13, vol. 57, p. 349.
Richardsonella belli RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 440.
Solenopleura trunca CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 26, pl. 4, fig. 1.
Tostonia trunca RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1121.

Cranidium characterized by the wide, somewhat oval glabella, strongly curved anterior rim, and sinuous occipital furrow.

The pygidium has a subtriangular outline, wide axis, and the pleural lobes possess strong, unfurrowed ribs. The smooth marginal area is narrow and concave. This is the largest known species of the genus.

Holotype (cranidium), Nat. Mus. Canada 853d; paratypes (cranidia), Nat. Mus. Canada 853c, e, f, g; (pygidium), Nat. Mus. Canada 717. Besides the types, a cranidium from boulder 36, North Ridge is figured.

LOGANELLUS MACROPLEURUS Rasetti, n. sp.
Plate 38, figures 15–17

The glabella has more convexity in longitudinal section than in any other species and almost reaches the anterior rim, leaving an exceedingly narrow preglabellar area. Only one pair of strongly oblique glabellar furrows is well impressed. One specimen preserves part of the thorax, which is remarkable for the strong macropleural development of the fifth segment.

Holotype and paratypes, Laval Univ. 1143a–d. Boulder 15, North Ridge.

LOGANELLUS? DUPLICATUS (Raymond)
Plate 38, figure 24

Tostonia duplicata RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1120, pl. 3, fig.17.

This and the following species were described by Raymond as *Tostonia*. From the general shape of the cranidia, these trilobites seem to be better placed in *Loganellus*, although they are not typical of that genus either.

The shape of the glabella, character of the glabellar furrows, and facial sutures are as

in *Loganellus*. However, compared with typical species of *Loganellus*, the eyes appear to be situated somewhat farther forward, and the rim is relatively wider and more strongly curved. Moreover, the surface is finely granulose, whereas all typical species of *Loganellus* are smooth. These differences do not seem to warrant the erection of a new genus, at least until the species become better known.

One cranidium from Lévis seems to belong to *L. duplicatus*. The specimen was collected from boulder 40, South Ridge.

LOGANELLUS? UNISULCATUS (Raymond)
Plate 38, figure 25

Tostonia unisulcata RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1121, pl. 3, fig. 18.

This species too seems to be represented in the Lévis boulders. Compared with *L. duplicatus*, it has a relatively wider glabella, narrower preglabellar area, and the glabellar furrows other than the posterior pair are more faintly impressed, although not altogether absent. Surface as in the preceding species.

The figured specimen from Lévis is Nat. Mus. Canada 838, being on the same piece of rock with one of the types of *Arionellus subclavatus*.

Genus LOGANOPELTIS Rasetti, 1943
LOGANOPELTIS ZENKERI (Billings)
Plate 38, figures 27, 28, 47

Conocephalites zenkeri BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 305, fig. 4; 1863, Geology Canada, p. 233, fig. 253; 1865, Canada Geol. Survey Palaeozoic Fossils, p. 398, fig. 375.
Ptychoparia zenkeri MILLER, 1889, North Am. Geology and Paleontology, p. 565, fig. 1052.
Loganopeltis zenkeri RASETTI, 1943, Jour. Paleontology, vol. 17, p. 104.

This trilobite much resembles in general aspect the type of the genus, *L. depressa* Rasetti. There are, however, important differences that may possibly require the erection of a new genus.

In *L. depressa* there is no trace of dorsal sutures. In *L. zenkeri* there certainly is no suture between the eye and the posterior margin of the cephalon. All specimens, however, show something like a ridge, which starts from the eye and is directed outward and forward, reaching the margin of the cephalon. The course of this ridge at first suggests that it should be considered as the anterior branch of the facial suture. This unusual state of affairs, *i.e.* the presence of the anterior branch of the facial suture without a posterior branch, is difficult to accept, unless no better explanation is available.

An alternative interpretation, suggested to the writer by Dr. C. H. Kindle (private communication) is the following. The two branches of the facial suture would be parallel and exceedingly close to each other, delimiting a narrow libragene of the proparian type. The libragene being missing in all the observed specimens, the irregular surface of the matrix where the test is absent would give the appearance of a ridge. Careful study of all the specimens available to the writer seems to support the latter interpretation. However, the unusually thin test of this trilobite and the consequent generally imperfect preservation make this investigation particularly difficult, and hence the writer refrains from expressing a final opinion.

Should the presence of proparian sutures in *Conocephalites zenkeri* be proved beyond doubt, then the species should be removed from *Loganopeltis*, although the close relationship between the two forms can hardly be doubted.

It may be added to Billings' description that the surface of the glabella is finely granulose, and that the genal angles are sharp but not extended into spines.

The associated pygidium has the same peculiar structure as that of *L. depressa*, possessing a short conical axis and four pairs of pleural ribs that are bent backward and somewhat inward. The pleural lobes end in a pair of flat spines as in *L. depressa*. The surface is finely granulose.

Holotype, Nat. Mus. Canada 849.

LOGANOPELTIS MINUTA Rasetti, n. sp.
Plate 38, figure 26

This name is given to a small pygidium, which differs from the one assigned to *L. zenkeri* by possessing one less pair of pleural ribs. The pleural lobes end in a pair of spines. The surface is more coarsely granulose than in *L. zenkeri*.

Holotype, Laval Univ. 1147. Boulder 12, North Ridge.

Genus ONCHONOTUS Raymond, 1924

Notwithstanding the large numbers of cranidia of *Onchonotus* that have been observed in the Lévis conglomerate, the author has been unable to identify the pygidia of these trilobites.

ONCHONOTUS GLOBOSUS (Billings)
Plate 38, figures 29, 30

Menocephalus globosus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 317, figs. 17–19; 1863, Geology Canada, p. 237, figs. 267a–c; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 408, figs. 388a–c.
Onchonotus globosus RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 405.

This is a rare species in the Lévis conglomerate, and is readily distinguished from all others of the genus by the large tubercles on the glabella and libragenes.

Holotype and paratypes, Nat. Mus. Canada 884g, 884a, d, k.

ONCHONOTUS RICHARDSONI (Walcott)
Plate 38, figures 31–34

Levisia richardsoni WALCOTT, 1911, Smithsonian Misc. Coll., vol. 57, no. 4, p. 86, pl. 17, figs. 4, 4a.
Onchonotus richardsoni RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 406.

In this species, the brim is slightly turned up at the edge instead of lying flat as in *O. nasutus*. There sometimes is a trace of one pair of glabellar furrows, represented by indentations on the sides. The longitudinal curvature of the glabella is evenly distributed. Surface smooth.

Holotype, U. S. Nat. Mus. 57599. The figured specimens are from boulder 1, North Ridge.

ONCHONOTUS NASUTUS (Walcott)
Plate 38, figures 38–40

Levisia nasuta WALCOTT, 1911 Smithsonian Misc. Coll., vol. 57, no. 4, p. 87, text figs. 7, 7a, pl. 17, fig. 5.
Onchonotus nasutus RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 407.

This species has a pointed, flat brim. The glabella usually is more convex anteriorly than posteriorly, and often shows a trace of two pairs of glabellar furrows as indentations on the sides. Surface smooth.

Holotype, U. S. Nat. Mus. 57600. Two specimens from boulder 36, North Ridge are figured.

ONCHONOTUS GRANULATUS Rasetti, n. sp.
Plate 38, figures 35–37

The cranidium of this species is exceedingly similar in shape to that of *O. nasutus*, except for the fact that the glabella is flatter, and its longitudinal convexity is evenly distributed. But the main distinctive character lies in the finely granulated surface of the test.

Holotype, Laval Univ. 1150a; paratypes, Laval Univ. 1150b–c. Boulder 38, North Ridge.

ONCHONOTUS CONVEXUS Rasetti, n. sp.
Plate 38, figures 41–43

This species is characterized by possessing a more convex glabella than any other of the Lévis species. The longitudinal convexity of the glabella is stronger posteriorly than anteriorly, whereas the opposite holds for *O. nasutus*. The anterior brim is slightly turned up as in *O. richardsoni*, from which it is distinguished by the more convex and proportionately shorter and wider glabella. There is no trace of glabellar furrows. Surface smooth.

It must be noticed that the three species *O. nasutus*, *O. richardsoni* and *O. convexus* are not always easy to distinguish from each other, as the differential characters may to some extent be masked by individual variability within each species. This applies in particular to the convexity of the glabella. When large series of specimens are available, the three species appear fairly clear-cut.

Holotype and paratypes, Laval Univ. 1152a–d. Boulder 32, Guay's quarry.

Genus ONCHOPELTIS Rasetti, n. gen.

Cranidium strongly arched in both directions. Glabella strongly convex, tapering, with faint oblique furrows; occipital furrow well impressed. Fixigenes narrow; eye lobes small, at the level of the glabellar midpoint and at a short distance from the glabella; ocular ridges present. Anterior facial sutures divergent; anterior angles of cranidium narrowly rounded. Rim wide, arched transversely; preglabellar area about as wide as the rim. Posterolateral limbs triangular. Libragenes wide, with strong genal spines. Surface tuberculated.

Genotype, *Onchopeltis spectabilis* Rasetti, n. sp.

Remarks.—This trilobite somewhat resembles some species that Kobayashi placed in *Dunderbergia*, subgenus *Megadunderbergia*, but it is doubtful whether it is closely related to them. Species of *Dunderbergia* usually possess a much wider brim.

ONCHOPELTIS SPECTABILIS Rasetti, n. sp.
Plate 39, figures 1–5

The generic description presents most of the characters of the cranidium of this species. The glabella shows two pairs of furrows, oblique and slightly curved. Rim moderately convex. Palpebral lobes short and narrow, set off by faint furrows; their distance from the glabella equals one-fifth of the glabellar width. Prominent parts of the glabella, fixigenes, and libragenes covered with strong tubercles. When the test is preserved, the surface between the large tubercles is seen to be covered with more numerous tubercles of a smaller size. Length of largest cranidium 25 mm.

The associated pygidium has a prominent axis occupying two-thirds of the length and more than one-third of the pygidial width. Axis with few annulations. Pleural lobes faintly segmented, with a concave marginal area. Posterior outline of pygidium regularly semicircular.

The stratigraphic position of this trilobite presents a problem. The boulder from which it was collected did not yield any of the forms of the *Hungaia* zone, but only trilobites of new or unidentified genera, besides a large gastropod, possibly *Tryblidium*. There is hardly any doubt that the fossils are Upper Cambrian. Dr. Resser, who examined the trilobites, suspected that this small faunal assemblage is of early Upper Cambrian (Dresbach) age.

Holotype and paratypes, Laval Univ. 1154a–f. Boulder 51, Middle Ridge.

Genus PLATYCOLPUS Raymond, 1913

The Lévis conglomerates contain, besides the genotype *P. capax* (Billings), a few other species of the genus. It is not easy to decide what species should be included in *Platycolpus*. *P. capax* and *P. eatoni* (Whitfield) possess a wide, inclined, striated rim and no preglabellar area. However, in establishing the genus Raymond included in it *Bathyurus dubius* Billings, which has a narrower rim than *P. capax* and a narrow preglabellar area. The close relationship between the two latter species is so obvious that it would appear unreasonable to separate them generically. Other species, such as *P. marcoui* and a new species here described, possess a still more definite preglabellar area. This character, as well as the lesser convexity of the cranidia, brings these species close to some forms that have been assigned to *Lecanopyge*. As stated in discussing the latter genus, the structure of the pygidia was taken as the discriminating character in these doubtful cases. Better knowledge of these trilobites may lead to establishing another genus for the forms that are intermediate between *Platycolpus* and *Lecanopyge*.

PLATYCOLPUS CAPAX (Billings)
Plate 39, figures 10–12

Bathyurus capax BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 318, fig. 20; 1863, Geology of Canada, p. 238, fig. 271a; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 409, fig. 389.

Platycolpus capax RAYMOND, 1913, Victoria Mem. Mus. Bull. 1, p. 63, pl. 7, figs. 20, 21.

Among the Lévis species, this is characterized by the large size, strong convexity, and absence of a preglabellar area.

Holotype, Nat. Mus. Canada 835e; paratype, 835f; plesiotype, 835c.

PLATYCOLPUS DUBIUS (Billings)
Plate 39, figures 13–14

Bathyurus dubius BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 319, fig. 21; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 410, fig. 390.

Platycolpus dubius RAYMOND, 1913, Victoria Mem. Mus. Bull., 1, p. 64.

The cranidium of this species is almost as convex as that of *P. capax*, but differs mainly in the presence of an exceedingly narrow preglabellar area. The glabella is slightly more tapering than in *P. capax*.

Holotype and paratypes, Nat. Mus. Canada 992, 992a–c.

PLATYCOLPUS MARCOUI Clark
Plate 39, figures 15, 16

Platycolpus marcoui CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 30, pl. 4, fig. 5.

This seems to be a rather small species, characterized by the depressed cranidium,

subrectangular glabella, well-defined preglabellar area, and narrow rim. There is a small tubercle on the occipital segment.

Holotype, Mus. Comp. Zool. 1710.

PLATYCOLPUS DEPRESSUS Rasetti, n. sp.
Plate 39, figures 7–9

The cranidium is depressed like that of *P. marcoui*, but the glabella is relatively narrower. The preglabellar area is somewhat wider than in that species, and the rim is also wider, rising abruptly from the preglabellar area and sloping gradually toward the outside. There is no tubercle on the neck segment. Libragenes rounded. Surface smooth. Length of largest cranidium 25 mm.

The pygidium is of the type usual in *Platycolpus*. It is less convex than the pygidium of *P. capax*, and traces of segmentation of the pleural lobes are apparent on exfoliated specimens.

Holotype and paratypes, Laval Univ. 1156a–d. Boulder 44, South Ridge.

Genus PLATYDIAMESUS Raymond, 1937

PLATYDIAMESUS? LEVISENSIS Rasetti, n. sp.
Plate 37, figure 40

A rare cranidium from the Lévis conglomerate is assigned to *Platydiamesus*, but it is by no means certain that this is its true generic position, as several genera of this type are difficult to separate.

Compared with *P. depressus* Raymond and *P. inornatus* Raymond, the new species differs mainly by possessing a somewhat wider brim. The rim is relatively wide and flat, and is set off from the preglabellar area by a sharp change in slope. The glabella is somewhat more convex in longitudinal section than in the above-mentioned species. The palpebral lobes and sutures are exactly as in the typical species of the genus. Length of holotype cranidium, 10 mm. Surface smooth.

Holotype, Laval Univ. 1137a. Boulder 39, North Ridge.

Genus PLETHOMETOPUS Ulrich, 1930

Species of *Plethometopus* are relatively common in the Upper Cambrian Lévis boulders. Most of them are small trilobites, and the writer has never found any individual that even approaches in size Billings' type specimen of *Bathyurus armatus*.

Study of these trilobites shows that it is difficult to maintain a sharp distinction between *Plethometopus* and *Stenopilus*, as there are represented all stages in the obliteration of the dorsal and occipital furrow.

PLETHOMETOPUS ARMATUS (Billings)
Plate 39, figure 25

Bathyurus armatus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 319, fig. 23; 1863, Geology of Canada, p. 238, fig. 273; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 411, fig. 392.

Plethopeltis armata RAYMOND, 1913, Victoria Mem. Mus. Bull., 1, p. 65, pl. 7, fig. 18.

Plethometopus armatus ULRICH, 1930, Missouri Bur. Geology and Mines, ser. 2, vol. 24, p. 221.

Holotype, Nat. Mus. Canada 863.

PLETHOMETOPUS LATICEPS Rasetti, n. sp.
Plate 39, figure 26

Characterized by the large size and the wide, depressed cranidium of length equaling the width. The occipital spine is large and conical and is set off by a relatively well impressed occipital furrow. A trace of the dorsal furrows is impressed along the posterior third of the glabella. Length of holotype cranidium, 16 mm.

Holotype, Nat. Mus. Canada. Lévis, North Ridge.

PLETHOMETOPUS ACUTUS Rasetti, n. sp.
Plate 39, figures 30, 31

This species is extremely similar to *P. convexus* (Whitfield), from which it differs mainly in possessing a deeper occipital furrow. The dorsal furrows are faintly impressed along the posterior third of the glabella. Length of cranidium 8 mm.

Syntypes, Laval Univ. 1162a–c. Boulder 44, South Ridge.

PLETHOMETOPUS ANGUSTUS (Raymond)
Plate 39, figures 28, 29

Plethopeltis angusta RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 417, pl. 13, figs. 4, 8.

Plethometopus angustus ULRICH, 1930, Missouri Bur. Geology and Mines, ser. 2, vol. 24, p. 221.

Holotype, Mus. Comp. Zool. 1733.

PLETHOMETOPUS CONVERGENS (Raymond)
Plate 39, figure 27

Plethopeltis convergens RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 419, pl. 13, fig. 2.

Plethometopus convergens ULRICH, 1930, Missouri Bur. Geology and Mines, ser. 2, vol. 24, p. 221.

Cranidia from boulder 32, Guay's quarry, appear to be identical with the type of this species, described from the Gorge formation.

The dorsal furrows are absent, and the occipital furrow is hardly impressed across the glabella but visible on the fixigenes. This cranidium is exceedingly similar to those of some species of *Stenopilus*.

Genus PSEUDOLISANIA Kobayashi, 1935

PSEUDOLISANIA HISINGERI (Billings)

Plate 37, figures 26, 27

Dikelocephalus hisingeri BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 196, fig. 182.

Conocephalites hisingeri MATTHEW, 1893, Royal Soc. Canada Trans., vol. 10, sec. 4, p. 11.

Lisania? hisingeri WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 351.

This species, represented only by the rather poorly preserved holotype cranidium, closely resembles in all features the genotype, *P. breviloba* (Walcott). The presence of exceedingly faint glabellar furrows seems to be the main distinctive feature.

Nothing is known of the associations of this species, hence it is possible that it does not belong to the *Hungaia* zone but rather to a lower stratigraphic horizon. The other known species of *Pseudolisania* are of early Upper Cambrian age.

Holotype, Nat. Mus. Canada 868a.

Genus PSEUDOSAUKIA Rasetti, n. gen.

Known from the cranidium alone. Glabella occupying most of the area of the

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EXPLANATION OF PLATE 38

FIGS. *1, 2—Leiocoryphe gemma* Clark. Top and side views of cast of cranidium, ×4; M.C.Z. 1706, holotype. (p. 245)

3—Leiocoryphe? brevis (Raymond). Cranidium, ×5; Laval U. 1138. (p. 245)

4—Leiocoryphe occipitalis Rasetti, n. sp. Cranidium, ×5; Laval U. 1139a, holotype. (p. 245)

5–7—Levisella oweni (Billings), ×1. *5*, Cranidium; N.M.C. 854, holotype. *6, 7*, Cranidium and pygidium; Laval U. 1140a, b, plesiotypes. (p. 246)

8, 9—Levisella affinis (Billings). *8*, Cranidium, ×1½; N.M.C. 891, holotype. *9*, Cranidium, 1; Laval U. 1141, plesiotype. (p. 246)

10–12—Levisella brevifrons Rasetti, n. sp. *10*, Cranidium, ×1½; Laval U. 1142a, holotype. *11*, United libragenes, ×1; Laval U. 1142b, paratype. *12*, Pygidium, ×1½; Laval U. 1142c, paratype. (p. 246)

13, 14—Loganellus logani (Devine). *13*, Specimen lacking the libragenes, ×1.2; N.M.C. 886, paratype. *14*, Almost complete specimen, ×1; N.M.C. 903, plastosyntype. (p. 247)

15–17—Loganellus macropleurus Rasetti, n. sp. *15, 16*, Cranidia, ×1½; Laval U. 1143b, c, paratypes. *17*, Cast of cranidium and part of thorax, ×2; Laval U. 1143a, holotype. (p. 247)

18–20—Loganellus belli (Billings), ×1. *18*, Cranidium; N.M.C. 853d, holotype. *19*, Cranidium; Laval U. 1144a, plesiotype. *20*, Pygidium figured by Billings as *Dikelocephalus* sp. undet.; N.M.C. 717. (p. 247)

21–23—Loganellus similis Rasetti, n. sp., ×1½. *21*, Cranidium; Laval U. 1145a, holotype. *22, 23*, Cranidium and pygidium; Laval U. 1145b, c, paratypes. (p. 247)

24—Loganellus? duplicatus (Raymond). Cranidium, ×4; Laval U. 1146. (p. 247)

25—Loganellus? unisulcatus (Raymond). Cranidium, ×3; N.M.C. 838. (p. 248)

26—Loganopeltis minuta Rasetti, n. sp. Pygidium, ×3; Laval U. 1147, holotype. (p. 248)

27, 28, 47—Loganopeltis zenkeri (Billings). *27*, Cranidium, ×1; N.M.C. 849, holotype. *28*, Cranidium, ×2; Laval U. 1148a. *47*, Pygidium, ×2; Laval U. 1148b. (p. 248)

29, 30—Onchonotus globosus (Billings). Top and side views of cephalon, ×3; N.M.C. 884g, holotype. (p. 249)

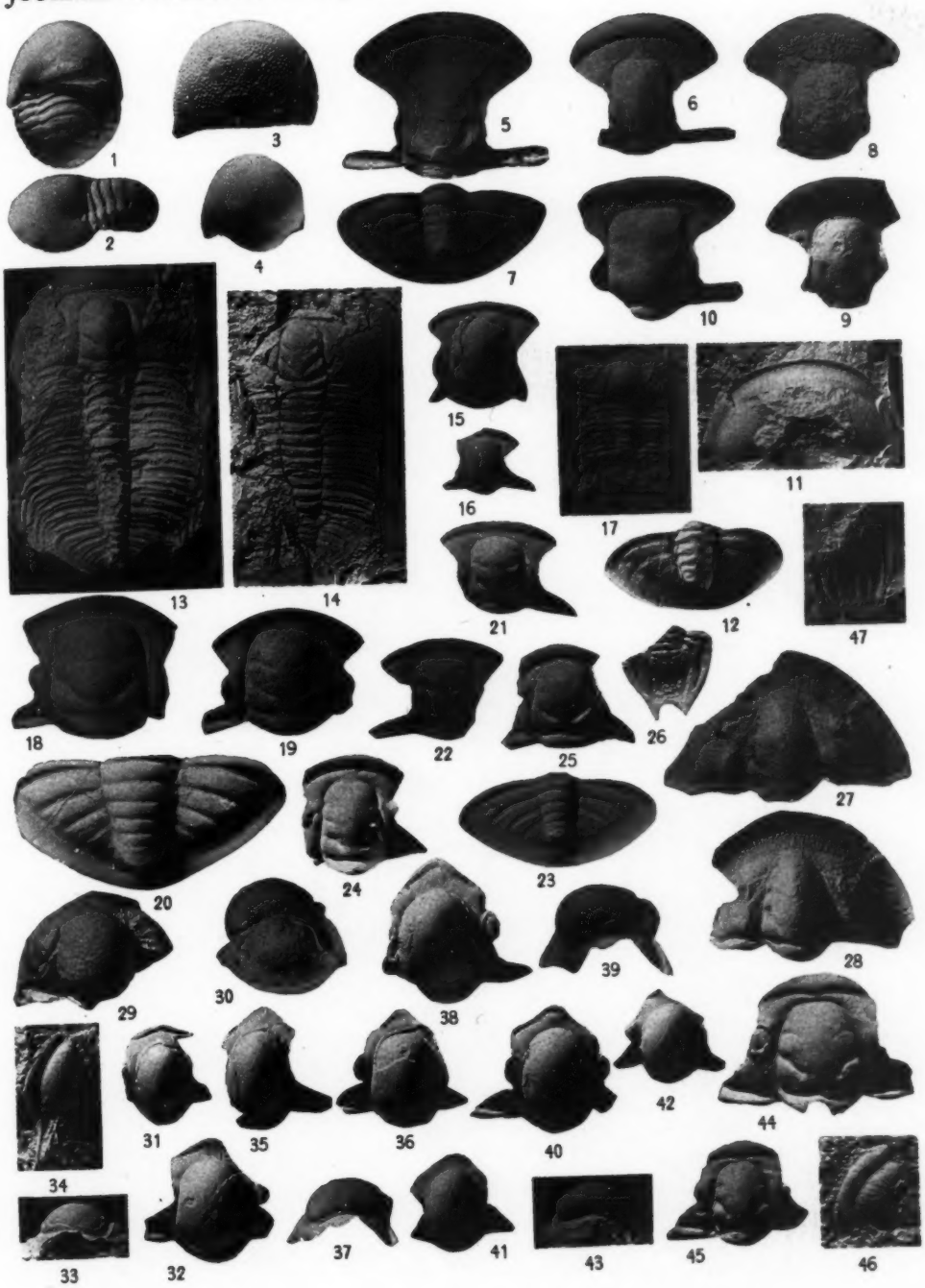
31–34—Onchonotus richardsoni (Walcott). *31, 33*, Top and side views of cranidium, ×1½; Laval U. 1149a. *32*, Cranidium, ×1½; Laval U. 1149b. *34*, libragene, ×1½; Laval U. 1149c. (p. 249)

35–37—Onchonotus granulatus Rasetti, n. sp., ×1½. *35*, Cranidium; Laval U. 1150b, paratype. *36, 37*, Top and side views of cranidium; Laval U. 1150a, holotype. (p. 249)

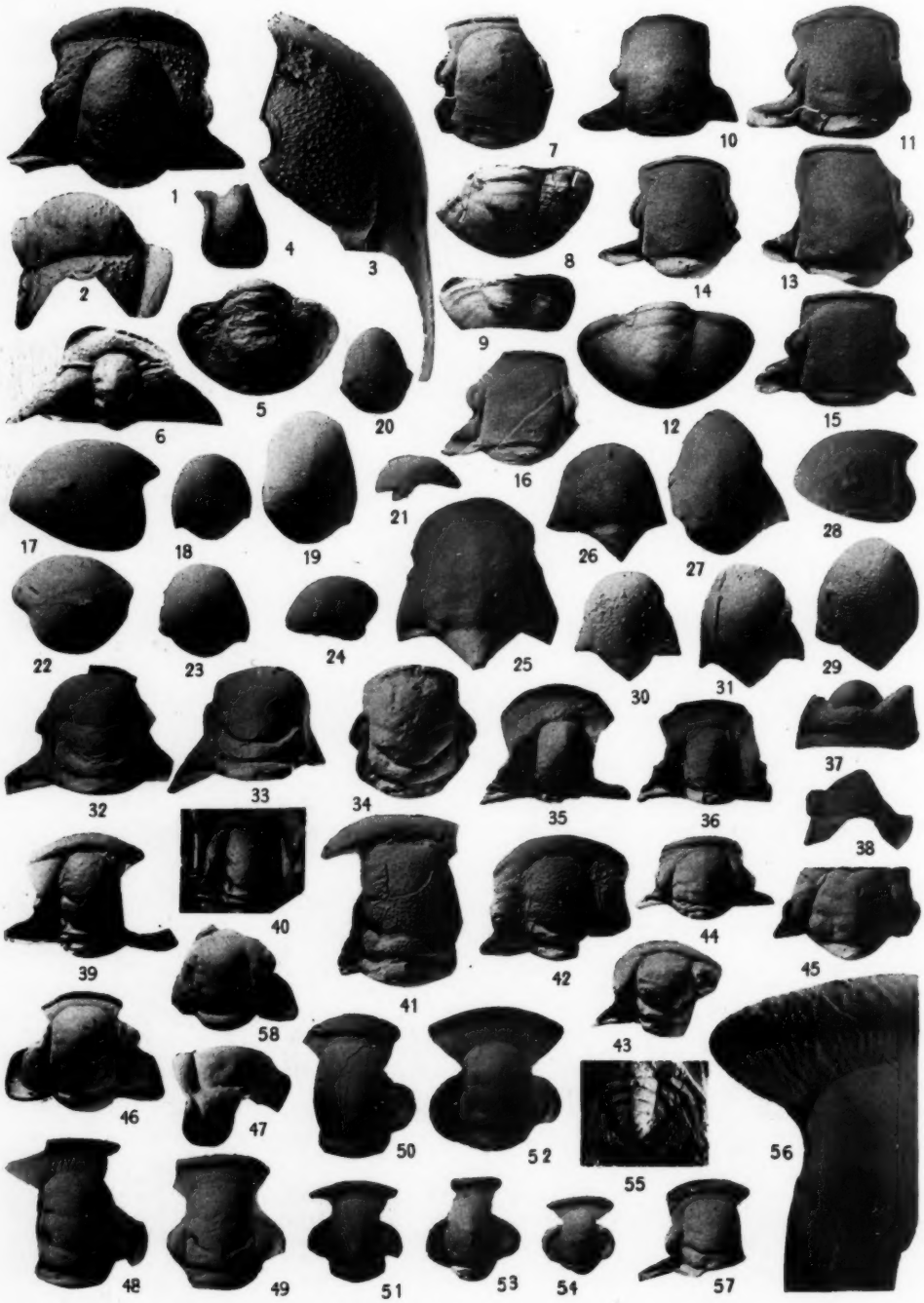
38–40—Onchonotus nasutus (Walcott), ×1½. *38*, Cranidium; *39, 40*, side and top views of another cranidium; Laval U. 1151a, b. (p. 249)

41–43—Onchonotus convexus Rasetti, n. sp., ×1½. *41*, Cranidium; Laval U. 1152b, paratype. *42, 43*, Top and side views of cranidium; Laval U. 1152a, holotype. (p. 249)

44–46—Talbotina? levisensis Rasetti, n. sp., ×3. *44*, Cranidium; Laval U. 1153a, holotype. *45*, Another cranidium; Laval U. 1153b, paratype. *45*, Libragene; Laval U. 1153c, paratype. (p. 257)



Rasetti, Upper Cambrian Trilobites from Lévis



Rasetti, Upper Cambrian Trilobites from Lévis

cranidium, oblong, parallel-sided, moderately convex. Posterior glabellar furrows continuous across the glabella. Eyes small, close to the glabella, somewhat obliquely situated, so that the anterior end of the palpebral lobe is in contact with the glabella. Anterior fixigenes exceedingly narrow; brim also very narrow, upturned. Posterior fixigenes relatively wide, triangular.

Genotype, *Dikelocephalus sesostris* Billings.

Remarks.—The glabella is practically identical with the form observed in several genera of the Saukiinae, but none of these genera present the extreme reduction of the brim and fixigenes, as well as the small eyes observed in *Pseudosaukia*. On the whole, close affinity with the Saukiinae appears questionable.

EXPLANATION OF PLATE 39

FIGS. *1–5—Onchopeltis spectabilis* Rasetti, n. gen., n. sp., ×1½. *1, 2*, Top and side views of cranidium; Laval U. 1154a, holotype. *3*, Libragene; Laval U. 1154b, paratype. *4*, Hypostoma; Laval U. 1154c, paratype. *5*, Pygidium; Laval U. 1154d, paratype. (p. 250)

6—Zacompsus? levisensis Rasetti, n. sp. Cranidium, ×5; Laval U. 1155, holotype. (p. 258)

7–9—Platycolpus depressus Rasetti, n. sp. *7*, Small cranidium, ×1½; Laval U. 1156, holotype. *8, 9*, Pygidia, ×1; Laval U. 1156b, c, paratypes. (p. 251)

10–12—Platycolpus capax (Billings). *10*, Cranidium, ×½; N.M.C. 835e, holotype. *11*, Smaller cranidium, ×1; N.M.C. 835f, paratype. *12*, Pygidium, ×½; N.M.C. 835c, plesiotype. (p. 250)

13, 14—Platycolpus dubius (Billings). ×1. *13*, Cranidium; N.M.C. 992a, paratype. *14*, Cranidium; N.M.C. 992, holotype. (p. 250)

15, 16—Platycolpus marcoui Clark, 1½. *15*, Cast of cranidium; M.C.Z. 1710, holotype. *16*, Another cranidium; N.M.C. (p. 250)

17, 18—Stenopilus dubius Rasetti, n. sp. *17*, Side view of cephalon, ×4; Laval U. 1157a, holotype. *18*, Cranidium, ×2; Laval U. 1157b, paratype. (p. 256)

19—Stenopilus pronus Raymond. Cranidium, ×1½; Laval U. 1158, plesiotype. (p. 257)

20, 21—Stenopilus elongatus Rasetti, n. sp. Top and side views of cranidium, ×2. Laval U. 1159a, holotype. (p. 257)

22–24—Stenopilus intermedius Clark, ×2. *22*, Side view of complete cephalon. *23*, Cranidium. *24*, Side view of another cranidium; Laval U. 1160a–c, plesiotypes. (p. 256)

25—Plethometopus armatus (Billings). Cranidium, ×1; N.M.C. 863, holotype. (p. 251)

26—Plethometopus laticeps Rasetti, n. sp. Cranidium, ×1; N.M.C., holotype. (p. 251)

27—Plethometopus convergens (Raymond). Cranidium, ×2; Laval U. 1161. (p. 251)

28, 29—Plethometopus angustus (Raymond). Side and top views of cast of cephalon, ×4; M.C.Z. 1733, holotype. (p. 251)

30, 31—Plethometopus acutus Rasetti, n. sp., ×2. Cranidia; Laval U. 1162a, b, syntypes. (p. 251)

32, 33—Pseudosaukia sesostris (Billings), ×1½. *32*, Cranidium; N.M.C. 855b, holotype. *33*, Cranidium; N.M.C. 855, paratype. (p. 254)

34—Pseudosaukia brevifrons (Clark). Cast of cranidium, ×5; M.C.Z. 1709, holotype. (p. 254)

35–38—Pterocephalops acrophthalma Rasetti, n. gen., n. sp., ×2. *35, 37*, Top and front views of cranidium. *36, 38*, Top and side views of another cranidium; Laval U. 1163a, b, syntypes. (p. 254)

39–41—Keithiella cylindrica (Billings), ×2. *39*, Cranidium; Laval U. 1164. *40*, Cranidium; N.M.C. 837a, holotype. *41*, Cranidium preserving part of the test; Laval U. 1165. (p. 243)

42—Keithiella depressa Rasetti, n. sp. Cranidium, ×2; Laval U. 1166a, holotype. (p. 243)

43—Keithiella brevis Rasetti, n. sp. Cranidium, ×3; Laval U. 1167, holotype. (p. 243)

44, 45—Quebecaspis breviceps Rasetti, n. gen., n. sp. Cranidia, ×2; Laval U. 1168a–b, syntypes. (p. 254)

46, 47, 58—Raymondina respecta Clark, ×5. *46, 47*, Top and side views of cranidium. *58*, Another cranidium with somewhat deeper glabellar furrows. Laval U. 1169a–b, plesiotypes. (p. 255)

48, 49—Richardsonella megalops (Billings), ×1½. Cranidia; N.M.C. 871a, 871c, syntypes. (p. 255)

50, 51—Richardsonella cristata (Billings), ×3. *50*, Cranidium; N.M.C. 870a, holotype. *51*, Another cranidium; N.M.C. 870b, paratype. (p. 256)

52—Richardsonella elongata Rasetti, n. sp. Cranidium, ×1½; Laval U. 1170, holotype. (p. 256)

53—Richardsonella convexa Rasetti, n. sp. Cranidium, ×3; N.M.C. 870d, holotype. (p. 256)

54–56—Richardsonella unisulcata Rasetti, n. sp. *54*, Small cranidium, ×2; Laval U. 1171a, holotype. *55*, Pygidium, ×2; Laval U. 1171b, paratype. *56*, Large fragmentary cranidium, ×5, showing surface structure; Laval U. 1171c, paratype. (p. 256)

57—Saukiella selecta (Billings). Cranidium, ×1; N.M.C. 879, holotype. (p. 256)

An undetermined trilobite described and figured by Stauffer (1940, p. 56, pl. 6, figs. 46–49) from the Van Oser beds of Minnesota (upper Trempealeau age) may belong to this genus.

PSEUDOSAUKIA SESOSTRIS (Billings)
Plate 39, figures 32, 33

Dikelocephalus sesostris BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 198, fig. 184.
Ptychaspis sesostris MILLER, 1889, North Am. Geology and Paleontology, p. 564, fig. 1052.

There is nothing to add to the original description.

Holotype, Nat. Mus. Canada 855b; paratypes, 855a, c–g.

PSEUDOSAUKIA BREVIFRONS (Clark)
Plate 39, figure 34

Osceolia brevifrons CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 30, pl. 4, fig. 4.

This species appears to differ from *P. sesostris* in the relatively larger eyes, wider brim, and the much smaller size. However, it is possible that these differences may be explained by the immature age of the individual that represents the type. Awaiting further proof on this point, Clark's species is recognized as distinct.

Holotype, Mus. Comp. Zoology 1709.

Genus PTEROCEPHALOPS Rasetti, n. gen.

Known from the cranidium alone. Glabella subrectangular, of average convexity. Occipital furrow well impressed; glabellar furrows faint or absent. Fixigenes rising steeply from the dorsal furrows and reaching at the palpebral lobes a level as high as the top of the glabella. Palpebral lobes small, situated backward of the glabellar midpoint and distant from the glabella about two-thirds of the glabellar width. The part of the fixigene which is anterior to a line drawn from the anterolateral angle of the glabella to the eye is sharply deflected downward. Since the rest of the fixigene slopes inward and somewhat backward, the fixigene appears sharply folded along the above-mentioned line. The brim just in front of the dorsal furrow is convex and attains an almost vertical slope; however, by assuming a concave profile, it terminates in a horizontal rim, which lies at a much lower level than the rest of the cranidium. The facial sutures are slightly divergent in front of the eyes.

Genotype, *Pterocephalops acrophthalma* Rasetti, n. sp.

Remarks.—The genus has been named in view of a certain resemblance to *Pterocephalina*. In top view, the cranidia of these two genera look alike, except for the fact that in *Pterocephalina* the eyes are much larger and closer to the glabella. However, the strong folding of the fixigenes is not present in *Pterocephalina*.

PTEROCEPHALOPS ACROPHTHALMA Rasetti, n. sp.
Plate 39, figures 35–38

There is little to add to the generic description. The glabella shows just a trace of one pair of glabellar furrows. The palpebral lobes do not show on the photographs, as they were broken in extracting the specimens from the matrix. Length of cranidium, 8 mm. Surface smooth.

Syntypes, Laval Univ. 1163a–c.

Boulder 51, Middle Ridge, associated with *Onchopeltis*. For a discussion of the stratigraphic position of this trilobite, see the description of the latter genus.

Genus QUEBECASPIS Rasetti, n. gen.

Known from the cranidium alone. Glabella weakly convex, well defined by the dorsal furrows, subtrapezoidal, truncated in front, slightly wider than long. Glabellar furrows faintly impressed; furrows of the posterior pair sharply bent backward. Fixigenes weakly convex, one-third as wide as the glabella. Palpebral lobes of medium length. Facial sutures parallel in front of the eyes; posterior branch delimiting small posterolateral limbs. Rim convex, almost straight; preglabellar area absent. Occipital segment wide, with a slender spine.

Genotype, *Quebecaspis breviceps* Rasetti, n. sp.

Remarks.—This trilobite seems to be close to *Lonchocephalus*, from which it differs mainly in the absence of the preglabellar area.

QUEBECASPIS BREVICEPS Rasetti, n. sp.
Plate 39, figures 44, 45

The generic description and the illustrations present most of the features of this

species. The length of the palpebral lobes is one-third the length of the glabella. There is a faint ocular ridge. Three pairs of glabellar furrows are visible, all of them exceedingly shallow. The occipital spine does not show on the photographs, as it is broken off in all available cranidia. Surface finely punctate. Length of largest cranidium 7 mm.

Syntypes, Laval Univ. 1168a–b.

Boulder 51, Middle Ridge. For the stratigraphic position of this fossil, see the discussion on *Onchopeltis*.

Genus RAYMONDINA Clark, 1924

RAYMONDINA RESPECTA Clark

Plate 39, figures 46, 47, 58

Raymondina respecta CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 35, pl. 4, fig. 8.

There is little to add to the original description, except that the genal angles of the cranidium are less extended than shown on Clark's illustration. However, examination of specimens supports Clark's interpretation of the sutures as proparian. The shape of the glabellar furrows is somewhat variable from one individual to another.

Holotype, Mus. Comp. Zoology 1716. The figured specimen is from boulder 38, North Ridge.

Genus RICHARDSONELLA Raymond, 1924

Protapatokephalus RAYMOND, 1937, Geol. Soc. America Bull., vol. 48, p. 1084.

Raymond placed in *Richardsonella* an assemblage of forms which, although related, differ among themselves in too many respects to be left in one genus. The name will be reserved for species strictly congeneric with the genotype, *R. megalops*. Some species were already separated by Ulrich as *Levisella*, others have been discussed under *Loganellus*. A new diagnosis of the restricted genus *Richardsonella* becomes necessary.

Cranidium of variable convexity. Glabella more or less tapering, with a variable number of furrows impressed, in some species smooth. Furrows, when present, oblique; posterior pair sometimes continuous across the glabella. Preglabellar area of variable width; rim always present. Anterior furrow marked by more or less distinct puncta. Palpebral lobes large, semicircular, close to the glabella. Anterior facial sutures starting from the dorsal furrows and then widely divergent. Posterolateral limbs narrow, parallel-sided.

Pygidium with a conical, strongly annulated axis and flat pleura turned backward and extended into spines.

The characters that distinguish *Richardsonella* from *Levisella* have been discussed in connection with the latter genus. *Richardsonella* differs from *Loganellus* mainly by the large eyes, the absence of anterior fixigenes, and the spinose pygidium.

As here restricted, *Richardsonella* comprises, besides the species here discussed, *R. arctostriata* (Raymond), *R. granulata* (Raymond), and *R. spiculata* (Raymond). The three latter species from the Gorge formation were described by Raymond (1937) under his new genus *Protapatokephalus*. Examination of casts of the types, however, shows that these species are perfectly typical of *Richardsonella*. Even the pattern of irregular striations that is present on the cranidium of *P. arctostriatus* is characteristic of *Richardsonella*, being observed in the genotype, *R. megalops*.

The identity of *Protapatokephalus* with *Richardsonella* does not impair Raymond's interpretation of these trilobites as ancestral to *Apatokephalus* and its allies, as both cranidia and pygidia show a striking resemblance. Such an affinity is strongly suggested, for example, when one compares *Richardsonella megalops* with *Diplapatokephalus levisensis* Rasetti, a species from the Lévis boulders of Lower Ordovician age.

RICHARDSONELLA MEGALOPS (Billings)

Plate 39, figures 48, 49

Dikelocephalus megalops BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 311, fig. 9; 1863, Geology of Canada, p. 236, fig. 257; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 403, fig. 380.

Conokephalina megalops WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 351.

Richardsonella megalops RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 438.

Characterized by two pairs of deeply impressed glabellar furrows, relatively wide, longitudinally striated preglabellar area, and well-marked puncta in the anterior furrow. When the test is preserved, the glabella shows a pattern of fine, irregular striations as in *R. arctostriata* (Raymond).

Syntypes, Nat. Mus. Canada 871a–f.

RICHARDSONELLA ELONGATA Rasetti, n. sp.
Plate 39, figure 52

This species resembles *R. megalops*, but the glabella has less longitudinal convexity and shallower furrows. The brim is wider than in *R. megalops*, and the puncta in the anterior furrow are hardly distinct.

Holotype, Laval Univ. 1170. Boulder 1, North Ridge.

RICHARDSONELLA UNISULCATA
Rasetti, n. sp.
Plate 39, figures 54–56

This species resembles *R. megalops* in the general proportions, but there is only one pair of faintly impressed glabellar furrows, and the preglabellar area is no wider than the rim.

A fragmentary cranidium preserves the test, which shows the beautiful surface structure so characteristic of several species of *Richardsonella*. A network of exceedingly fine ridges covers the whole cranidium, forming a pattern that reminds one of fingerprints.

An associated pygidium is referred to this species. The pygidium presents the same surface structure as the cranidium, so that it is exceedingly unlikely that it belongs to any other trilobite. The axis has three strongly defined segments besides a terminal section. The pleura are flat, turned backward, and end in three pairs of flat spines of decreasing length.

Holotype and paratypes, Laval Univ. 1171a–c. Boulder 15, North Ridge.

RICHARDSONELLA CRISTATA (Billings)
Plate 39, figures 50, 51

Dikelocephalus cristatus BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 312, fig. 10; 1863, Geology of Canada, p. 236, fig. 258; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 404, fig. 381.
Conokephalina? cristata WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 350.
Richardsonella cristata RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 440.

This species has a strongly convex, unfurrowed glabella. The characteristic feature is the elevation of the posterior part of the glabella into a ridge, which falls abruptly in front of the occipital furrow.

Holotype, Nat. Mus. Canada 870a; paratypes, 870b, c.

RICHARDSONELLA CONVEXA
Rasetti, n. sp.
Plate 39, figure 53

Similar to *R. cristata* in possessing a strongly convex, unfurrowed glabella, this species differs mainly because the glabella is not elevated into a ridge. Moreover, the palpebral lobes are less curved and closer to the glabella, hence they do not enclose a semicircular area of the fixigene as in the other species of the genus.

Holotype, Nat. Mus. Canada 870d; paratypes, 870, 877i. Band 3 or 4, North Ridge.

Genus SAUKIELLA Ulrich and Resser, 1933
SAUKIELLA SELECTA (Billings)
Plate 39, figure 57

Dikelocephalus selectus BILLINGS, 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 199.
Ptychaspis? selectus WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 352.

This is the only known representative of the Saukiinae in the Lévis fauna. The surface seems to be smooth, hence the species cannot be placed in *Saukia* as restricted by Ulrich and Resser. The shape of the cranidium seems best to agree with *Saukiella*, although *Saukiella* and *Prosaukia* are so similar that reference to the latter genus cannot be excluded.

Holotype, Nat. Mus. Canada 879.

Genus STENOPILUS Raymond, 1924
STENOPILUS INTERMEDIUS Clark
Plate 39, figures 22–24

Stenopilus intermedius CLARK, 1924, Bull. Am. Paleontology, vol. 10, no. 41, p. 22, pl. 3, fig. 9.

This is a common species in the Lévis boulders. A complete cephalon from boulder 42, South Ridge, is illustrated. The librigenes are rather wide, broadly rounded posteriorly. The anterior branch of the facial suture is slightly intramarginal to the center.

Holotype, Mus. Comp. Zoology 1707. Plesiotype (cephalon), Laval Univ. 1160a.

STENOPILUS DUBIUS Rasetti, n. sp.
Plate 39, figures 17, 18

The absence of an occipital furrow and an occipital spine places this species in *Stenopilus*, but under any other respect the cephalon closely resembles that of *Plethometopus*

angustus. From *S. intermedius*, the present species differs in the more sinuous posterior outline of the cranidium, due to the more marked extension of the occipital segment and of the posterolateral limbs. The librigenes maintain an even width from the eyes to the posterior end, whereas they taper strongly in *S. intermedius*.

Holotype and paratypes, Laval Univ. 1157a–d. Boulder 32, Guay's quarry.

STENOPILUS PRONUS Raymond
Plate 39, figure 19

Stenopilus pronus RAYMOND, 1924, Boston Soc. Nat. History Proc., vol. 37, p. 420, pl. 13, figs. 6–7.

One cranidium from Lévis seems to be identical with the type of the species. It was collected from boulder 40, South Ridge.

STENOPILUS ELONGATUS Rasetti, n. sp.
Plate 39, figures 20, 21

This species is very close to *S. pronus*, from which it differs by the stronger convexity of the posterior part of the cranidium and by the constantly much smaller size. Length of cranidium 6 mm.

Holotype, Laval Univ. 1159a. Boulder 32, Guay's quarry.

Genus STIGMAMETOPUS Rasetti, n. gen.

Small trilobites known from the cranidium alone. Cranidium almost regularly semicircular, strongly trilobed. Glabella narrow, occupying almost the whole length of the cranidium, widest at the middle, tapering at both ends, delimited by dorsal furrows that are deep posteriorly and gradually become shallower anteriorly. Occipital furrow and one pair of glabellar furrows deeply impressed across the glabella; two other pairs represented by deep pits in the dorsal furrows. Fixigenes on the average as wide as the glabella, strongly convex transversely, anteriorly forming a brim without rim. Facial sutures represented by a pair of anteriorly situated indentations in the outline of the fixigenes; there appear to be no palpebral lobes.

Genotype, *Stigmametopus levisensis*, n. sp.

Remarks.—The general form of the cranidium suggests affinity with *Idiomesus*, from which the new genus is readily distinguished by the deep glabellar furrows.

STIGMAMETOPUS LEVISENSIS Rasetti, n. sp.
Plate 37, figures 8, 9

The generic description and the illustrations present all the known characters of this species. None of the cranidia exceed 3 mm. in length.

Syntypes, Laval Univ. 1126a–b. Boulder 38, North Ridge.

Genus TALBOTINA Lochman, 1938
TALBOTINA? LEVISENSIS Rasetti, n. sp.
Plate 38, figures 44–46

Glabella of average convexity, with two pairs of furrows. Furrows of the posterior pair rather deeply impressed, curved backward, extending across one-third the width of the glabella; furrows of the other pair shorter and shallower. Fixigenes on the average one-third as wide as the glabella. Position and size of eyes average for the genus; ocular ridges faint. Rim strongly convex, expanding at the center, where the preglabellar area is exceedingly narrow. Occipital furrow deep; occipital segment somewhat expanding at the center. Length of cranidium, 6 mm. Surface almost smooth.

This species differs from most of those described in possessing deeper glabellar furrows and a narrower preglabellar area.

Numerous cranidia were collected from one boulder. The boulder yielded no other fossils by which its stratigraphic position could be ascertained. If the assignment to *Talbotina* is correct, it suggests an early Upper Cambrian age, as the known species of *Talbotina* occur in strata of Dresbach age.

Holotype and paratypes, Laval Univ. 1153a–d. Boulder 41, South Ridge.

Genus TATONASPIS Kobayashi, 1935
TATONASPIS LEVISENSIS Rasetti, n. sp.
Plate 37, figures 11, 12

Two species from the Gorge formation described by Raymond, *Illaenurus punctatus* and *I. breviceps*, do not seem to belong to that genus but rather to present closer affinity with two genera described by Kobayashi from Alaska and the Northwest Territory of Canada, *Tatonaspis* and *Yukonaspis*, and especially with the former.

The present species is almost identical with *T. punctata* (Raymond), from which it

appears to differ only in the absence of a striated doublure, which, according to Raymond, in his species is visible from above. The surface is punctate as in Raymond's species.

Syntypes, Laval Univ. 1128a–b. Boulder 36, North Ridge.

Genus ZACOMPSUS Raymond, 1924
ZACOMPSUS? LEVISENSIS Rasetti, n. sp.
Plate 39, figure 6

The present species possesses some of the characters of Raymond's genera *Zacompsus* and *Phylacterus* and seems to be better placed in the former.

Glabella narrow, parallel-sided, with two pairs of short, well-impressed glabellar furrows starting from the dorsal furrows. Eyes small, distant from the glabella about two-thirds of the glabellar width, connected to the glabella by strong ocular ridges, which are directed slightly forward on account of the anterior position of the eyes. Brim with a considerable convexity in longitudinal section, limited by a narrow rim. Anterior facial sutures slightly convergent. Posterolateral limbs large. Length of holotype cranidium, 3 mm.

This species differs from *Z. clarki* Raymond in possessing a parallel-sided instead of an expanding glabella, well-impressed glabellar furrows, and a wholly convex brim.

Holotype, Laval Univ. 1155. Boulder 15, North Ridge.

GENUS UNDETERMINED
"MENOCEPHALUS" SEDGWICKI Billings
Plate 36, figure 56

Menocephalus sedgwicki BILLINGS, 1860, Canadian Naturalist, vol. 5, p. 316, fig. 19; 1863, Geology of Canada, p. 237, fig. 266; 1865, Canada Geol. Survey Palaeozoic Fossils, vol. 1, p. 407, fig. 387.

The only specimen now preserved in the collections of the Geological Survey of Canada shows no more than the glabella, the brim and fixigenes being broken off or obscured by the matrix. Under such circumstances, generic identification is hardly possible. Probably the species does not belong to any described genus, but it does not seem opportune to establish a new one on such fragmentary material. All that is known about this species results from Billings' description and illustration.

Holotype, Nat. Mus. Canada 855.

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NEW TABULATE CORALS FROM THE PENNSYLVANIAN OF TEXAS

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ABSTRACT—Descriptions of three new species of *Striatopora* from Texas: *S. moorei*, from the Strawn group, *S. plummeri*, from the lower Canyon group, and *S. trachyporoides*, from the *Uddenites* zone of the Gaptank formation. The holotype of the genotypic species, *S. flexuosa*, of the Middle Silurian of New York, is refigured, and figures are given of *S. austini* of the Missouri series of Kansas.

THE TABULATE corals described below were collected by F. B. Plummer of the Bureau of Economic Geology, Austin, Texas, to whom the writer is indebted for the opportunity of studying them. With the described material were also specimens belonging to another new tabulate species, but since this has been described by R. C. Moore in a manuscript on Pennsylvanian corals now awaiting publication, it is not included here.

Holotype and paratype specimens are in the Geological Museum of The Ohio State University (O.S.U.); duplicate paratypes have been deposited at the Bureau of Economic Geology (B.E.G.).

The three new species all belong to the tabulate genus *Striatopora*, the type of which is *S. flexuosa* Hall from the Middle Silurian Rochester shale of New York. Other species are known from the Devonian and Mississippian, and several have been described from the Pennsylvanian of Kansas, Oklahoma, and Arkansas. The new forms are from the Pennsylvanian of Texas, and extend the range of *Striatopora* upward to the summit of this system in this country. The distribution of the American Pennsylvanian species is summarized at the top of the next column.

Lower Pennsylvanian.
S. oklahomensis (Snider), Morrow formation, Oklahoma and Arkansas.
Middle Pennsylvanian.
Striatopora moorei Wells, n. sp., Strawn group, Texas.
S. austini (Worthen), Bethany Falls limestone, Kansas.
Upper Pennsylvanian.
S. plummeri Wells, n. sp., lower Canyon group, Texas.
S. trachyporoides Wells, n. sp., Gaptank formation, Texas.

Genus STRIATOPORA Hall, 1851

Striatopora HALL, 1851, Am. Jour. Sci., ser. 2, vol. 11, p. 400.

Striatopora and its ally *Trachypora* are closely related to *Thamnopora*, the last including the genotype and most species of *Pachypora* (Hill, *1937*, p. 56; Lecompte, *1939*, p. 102; Lang, Smith, and Thomas, *1940*, p. 133). Together with *Favosites*, these genera form a graded series: *Favosites* → *Thamnopora* → *Striatopora* → *Trachypora*, marked by the increasing dilatation of the inner corallite walls. The distinctions between adjacent genera are not sharp, especially between *Thamnopora* and *Striatopora*. In these genera the criteria seem to be as follows (Lecompte, *1939*, p. 104; Hill, *1937*, p. 56):

	Thamnopora	*Striatopora*
Mural dilatation.	Nearly uniform from axis, slightly increasing distally.	Very slight axially. Very great distally.
Form of calices.	Practically cylindrical down to last tabula.	Infundibuliform.
Septal spines.	Weak; commonly absent.	Developed, superficially expressed as pseudoseptal ridges, especially in larger calices.

Through the kindness of Dr. H. E. Vokes of the American Museum of Natural History the writer has been able to examine Hall's types of *S. flexuosa*. New figures of the lectotype (A.M.N.H. No. 1685; Hall, *1852*, pl. 40B, fig. 1a,?1d) are given on plate 40, figs. 1, 2. They confirm the analysis given above, and allowing for specific differences, indicate that the Pennsylvanian species are certainly congeneric with the genotype. In *S. flexuosa* the corallites are apparently unimorphic, and the branches are much more slender (rarely more than 4 mm. in diameter) and more attenuate, with the corallites upwardly inclined from the axis of the branch and the calices opening toward its tip. These conditions, unimorphism and inclination of corallites, are almost invariably found in such thinly branched ramose corals, the first because new corallites are added almost exclusively at the growing tip. In more stoutly branched coralla the corallites are first inclined upwards, then outwards, so that their axis of growth becomes more nearly normal to the surface as the branch thickens. In such forms new corallites are budded off not only near the tips, where they attain full size, but also are offset peripherally from the lateral corallites and may not attain full size, producing an apparent dimorphism. This adjustment of the axis of growth to the thickness produces very marked differences in the shape of the calices.

STRIATOPORA MOOREI WELLS, n. sp.
Plate 40, figures 3–10

Corallum ramose, branches cylindrical or very slightly compressed, blunt, branching at about 90°, thickness 6 to 35 mm., averaging 16 mm. Corallites dimorphic, diameter of larger ones averaging 2.5 mm., with a minimum of 2.2 mm.; smaller ones averaging 1.5 mm., ranging from 1.0 to 1.8 mm. Calices circular or rounded polygonal in outline, up to 3 mm. in depth and from 2 to 5 mm. apart between rims; smaller calices commonly definitely polygonal, with thin rims; rims of larger ones protuberant, slightly inclined upwards. Walls heavily dilatated beginning about 1 mm. below the rims, and internally the corallites are almost completely filled except in the tabulated axial region of the branch. Pseudosepta 12, present in all corallites, but distinctly developed only in larger ones. Mural pores (rather, canals) open, intercommunicating directly through the fused dilatated corallite walls, spaced 0.75 to 1.5 mm. apart vertically, averaging 1 mm. Tabulae axially well developed, flat, 0.5 to 1.0 mm. apart. The tabulated, nondilated axial region of the branches is about one-third the diameter of the branches.

Occurrence.—Five feet above the Marble Falls limestone, probably Mineral Wells shale, Strawn group, middle Pennsylvanian, North side of road 400 feet northwest of old silos on the Morgan Ranch, about 5 miles southeast of London and 900 feet north of the Llano River, Kimble County, Texas. Eighty-four specimens examined.

Types.—Holotype, O.S.U. No. 19500; paratypes, O.S.U. Nos. 19497, 19498, 19499. Also duplicate topotype specimens (not seen by writer), B.E.G. Nos. P-12678, P-13416, P-13799.

Remarks.—The size of the corallites and general aspect of the corallum of this species suggest *S. austini* (Worthen) (1890, p. 81, pl. 11, figs. 1–1d) of the Bethany Falls limestone (Bronson group, Missouri series) in Labette County, Kansas, more adequate figures (pl. 41, figs. 1–5) of which are published here for comparison. In *S. moorei*, however, the tabulae are more numerous and better developed, the mural pores are relatively fewer, dimorphism of the corallites is usually

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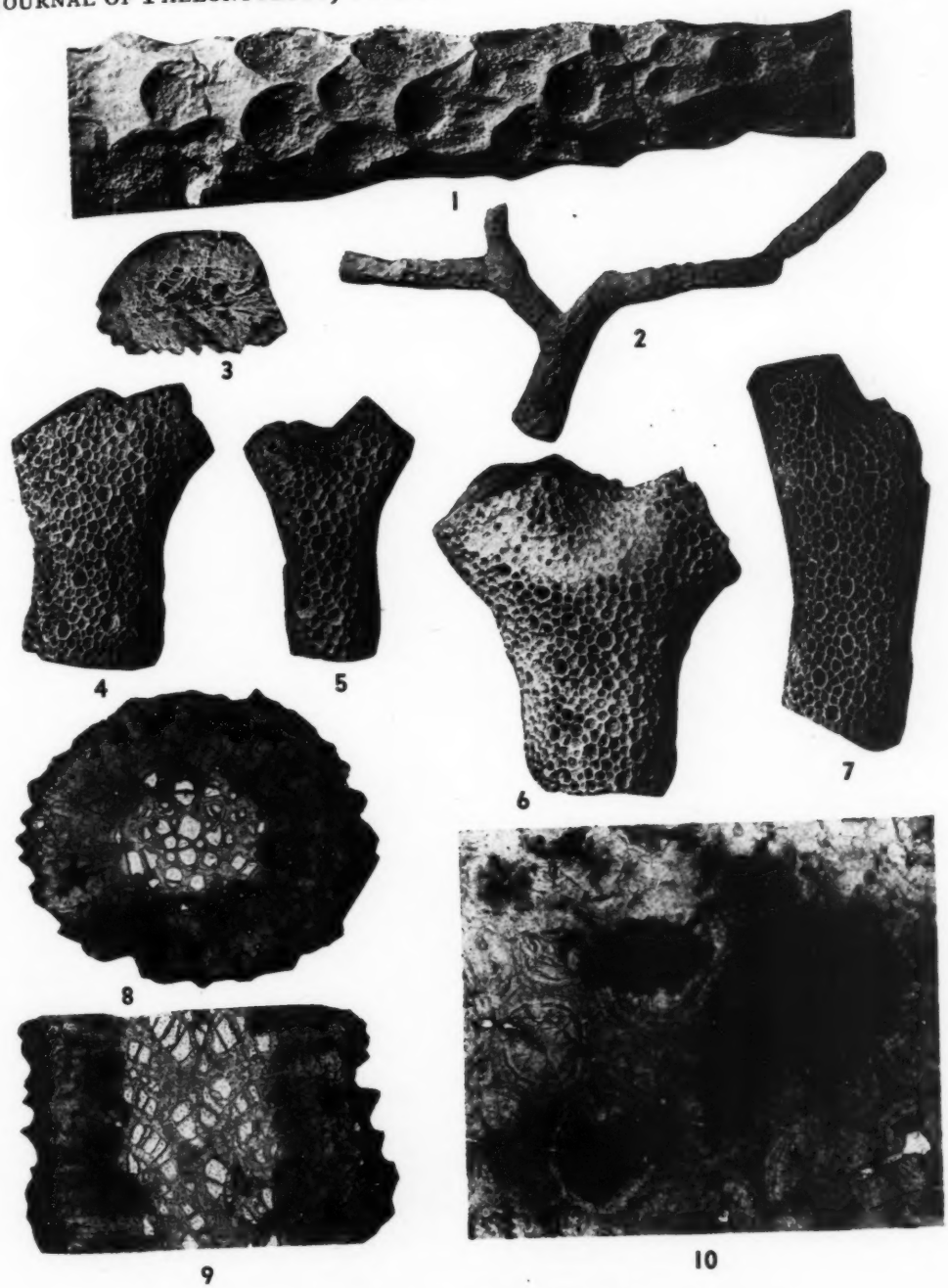
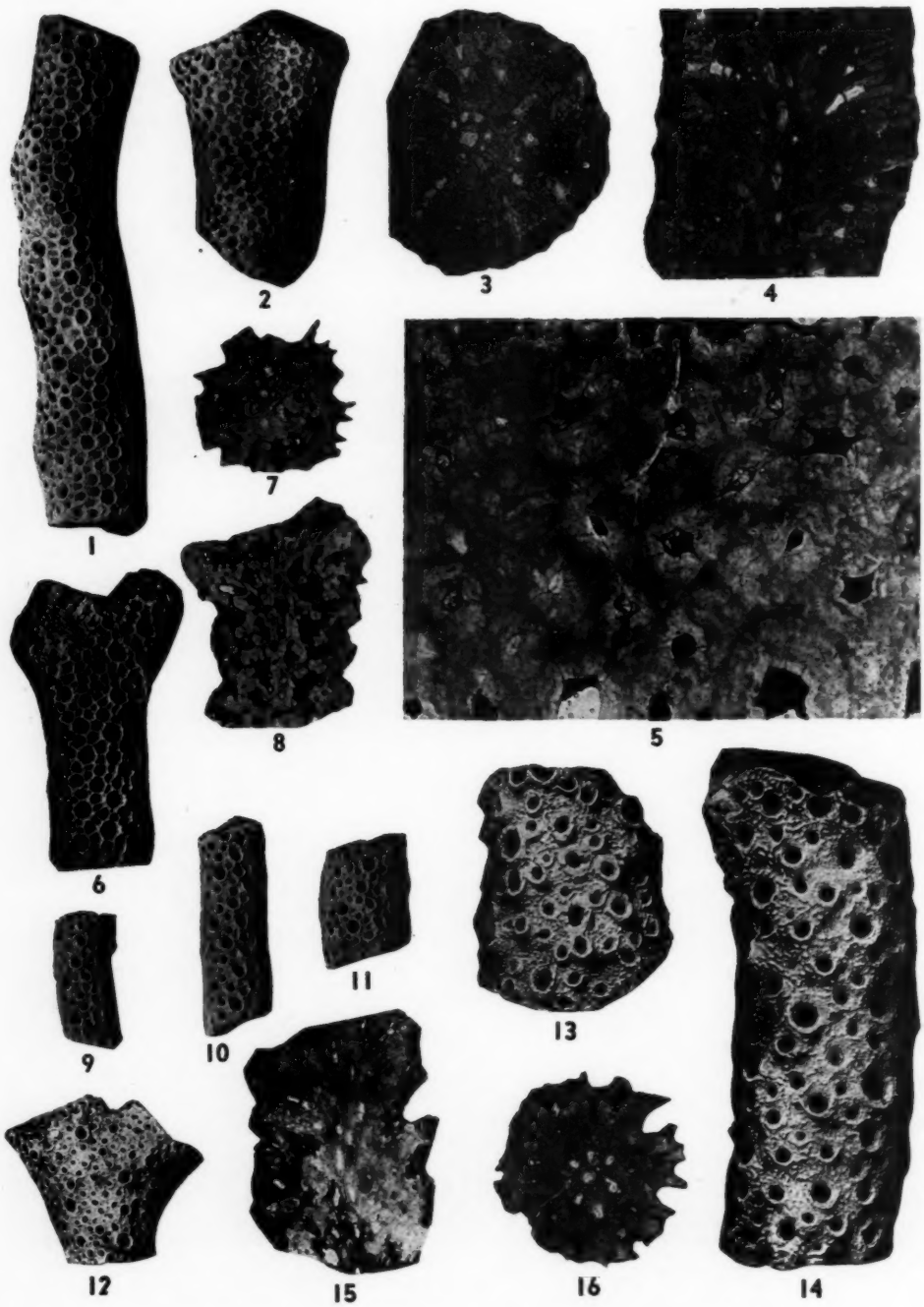
EXPLANATION OF PLATE 40

FIGS. *1, 2*—*Striatopora flexuosa* Hall. Holotype (A.M.N.H. No. 1685), Middle Silurian, New York. *1*, Calices, ×6; *2*, general aspect, ×1. (p. 260)

3–10—*Striatopora moorei* Wells, n. sp. Strawn group, Texas. *3*, Natural transverse section of paratype (O.S.U. No. 19498), ×1; *4–6*, general aspect of paratypes (O.S.U. No. 19498), ×1; *7*, general aspect of holotype (O.S.U. No. 19500), ×1; *8, 9*, transverse and longitudinal sections of paratype (O.S.U. No. 19499), ×2.2; *10*, tangential section of paratype (O.S.U. No. No. 19499) just below calices, ×6. (p. 260)



Wells, Pennsylvanian Tabulate Corals from Texas



Wells, Pennsylvanian Tabulate Corals from Texas

less pronounced, and the axial nondilated zone is proportionally larger.

S. oklahomensis (Snider) (1915, p. 72, pl. 3, figs. 7, 8), described from the "Chester" (=Morrow formation) of Oklahoma, and which may include *Pachypora carbonaria* Mather (1915, p. 94, pl. 1, figs. 15–16) from the Morrow formation in Arkansas and Oklahoma (not *Striatopora carbonaria* White, 1862, from the Burlington of Iowa), occurs below the horizon of *S. moorei*. The two species are very closely related. *S. oklahomensis* has the same stout growth form, dimorphic corallites of about the same size, deep calices, but the tabulae are less regularly arranged, many of them not extending across the corallite cavity and arching diagonally to fuse with the ones below.

STRIATOPORA PLUMMERI Wells, n. sp.
Plate 41, figures 6–8

Corallum ramose, branches cylindrical, blunt, branching at 90°, thickness 7 to 15 mm., usually between 10 and 12 mm. Corallites dimorphic, diameter of larger ones 1.5 to 2.5 mm., commonly about 2.5 mm.; smaller ones 1 to 1.5 mm., averaging nearly 1.5 mm. Calices rounded polygonal in outline, very deep, as much as 5 mm., averaging 3 mm., larger ones more nearly circular with thin raised rims considerably higher than those of the smaller corallites. The upper edge of the wall, the calyx rim, is discontinuous, broken by incipient mural pores and in perfect material would appear somewhat crispate. Walls thin, very slightly dilated just below the upper edge, but thickened axially, the lower part of the calyx in thick branches being reduced to a tube which internally is completely choked. Pseudosepta 12 in number, well developed, low and rounded, extending to calyx rim but much reduced on their outer extremities. No tabulae apparent, even in the largest specimens. Mural pores well developed, open in deepest parts of calices, even in the axial region, regularly spaced about 0.75 mm. apart, five or six of them radiating through the wall at the same level in a corallite. Axial region weakly defined, about one-third the diameter of the branches.

Occurrence.—Base of Graford formation, lower Canyon group, upper Pennsylvanian. Bridgeport clay pit, Bridgeport, Wise County, Texas. Fourteen specimens examined.

Types.—Holotype: O.S.U. No. 19496; paratypes, O.S.U. No. 19494, 19495. Also duplicate topotype specimens (not seen by writer), B.E.G. Nos. 5262, 5263.

Remarks.—Readily distinguished from *S. moorei* and *S. austini* by the smaller, much deeper calices and the absence of tabulae. The absence of tabulae is not necessarily a valid specific criterion, but in the present case it may be. It is correlated with the relatively slender branches and short corallites. In *S. moorei* the branches are thicker, consequently the corallites are longer, and undoubtedly rapid outward growth continued after maturity, resulting in the development of tabulae before dilatation internally choked the lower part of the corallites and obviated the possibility of tabular development.

STRIATOPORA TRACHYPOROIDES Wells, n. sp.
Plate 41, figures 9–16

Corallum ramose, branches cylindrical or slightly compressed, slender, blunt, branching at 90°, thickness 7 to 13 mm., averaging

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EXPLANATION OF PLATE 41

FIGS. *1–5*—*Striatopora austini* (Worthen). Topotypes (O.S.U. No. 18428), Bethany Falls limestone, Kansas. *1, 2*, General aspect of branches, ×1; *3, 4*, transverse and longitudinal sections, ×2.2; *5*, tangential section below calices, ×6. (p. 260)

6–8—*Striatopora plummeri* Wells, n. sp. Lower Canyon group, Texas. *6*, General aspect of holotype (O.S.U. No. 19496), ×1; *7, 8*, transverse and longitudinal sections of paratype O.S.U. No. 19495), ×2.2. (p. 261)

9–16—*Striatopora trachyporoides* Wells, n. sp. *Uddenites* zone, Gaptank formation, Glass Mountains. *9–11*, General aspect of three paratypes (O.S.U. No. 19491), ×1; *12, 13*, general aspect of two paratypes (O.S.U. No. 19492), ×1, ×2.2; *14*, holotype (O.S.U. No. 19493), ×2.2; *15*, longitudinal section of paratype (O.S.U. No. 19492); *16*, transverse section of paratype, fig. *11* (O.S.U. No. 19491), ×2.2. (p. 261)

about 10 mm. Corallites dimorphic, diameter of larger ones averaging 2 mm., ranging from 1.5 to 2.5 mm.; smaller ones averaging 1 mm., ranging from 0.5 to 1.5 mm. Calices commonly circular in outline, internally infundibuliform, tapering gently to the bottom, deep (as much as 3 mm.), apparently open in some corallites very nearly to the axis of the branch, more or less protuberant, subnariform, with thin, interrupted rims. Protuberant part of calices of larger corallites only slightly dilated, but the walls of the smaller calices are heavily dilated and seem flush with a general surface. Pseudosepta 12, low and rounded, appearing on the upper stereomal calicular surface as well-defined isolated ridges. Walls greatly dilated internally, but thin at the calicular rims, appearing around the smaller calices as fine ridges on the stereomal surface interrupted by incipient mural pores. Mural pores more or less regularly spaced about 0.5 mm. apart. Tabulae usually not developed except in lower parts of occasional long corallites, about 0.5 mm. apart. Axial region weakly defined, about one-fourth the diameter of the branch.

Occurrence.—*Uddenites* zone of the Gaptank formation, upper Pennsylvanian. West of Wolfcamp, Glass Mountains, Brewster County, Texas. Twenty-eight specimens examined.

Types.—Holotype, O.S.U. No. 19493; paratypes, O.S.U. Nos. 19489, 19490, 19491, 19492. Also topotype specimens (not all seen by writer) B.E.G. Nos. 2162, P-6507, 6761, 7345, P-9572, 9660.

Remarks.—This species is marked by the subnariform calices and the tremendous development of stereome in the smaller corallites. By this development the calyx floor, except for a small axial space, is flattened and raised nearly to the level of the calicular rim. In some well-preserved larger branches the smaller calices appear to be set in stereome, the surface of which is marked by interrupted ridges. In smaller branches, evidently not mature, this excessive dilatation is not evident, and there is much less differentiation between the corallites except for size. In some specimens the protuberant larger calices seem to have pseudoseptal ridges extending over their outer sides, but these are considered to represent the pseudosepta of the inferior, peripherally extended polyps of the smaller corallites.

There is an approach in this species to the condition in *Trachypora*. In that genus the calices are proportionally fewer and much larger and appear as if isolated in the midst of an extensive vermiculated perithecal surface, whereas in *S. trachyporoides* the peritheca is hardly vermiculated and in most specimens the corallite walls are distinct.

MANUSCRIPT RECEIVED APRIL 20, 1943

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 3, PP. 263–264, 4 TEXT FIGS., MAY 1944

THE HULL BRYOZOAN ESCHAROPORA HOGBENI

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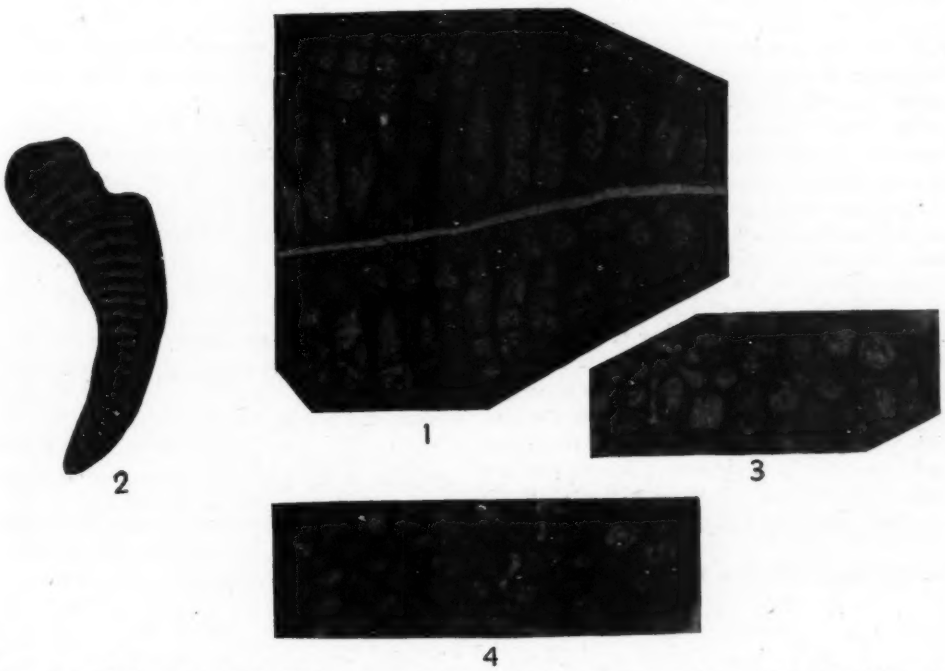
THIS NEW species is known at present by four specimens only. The holotype was obtained by Murray Hogben of Ottawa from the Hull beds of the Trenton at Hull, Quebec; three paratypes were collected by Winston Sinclair from the same locality. A description of the species follows:

ESCHAROPORA HOGBENI Fritz, n. sp.
Figures 1–4

External features.—Zoarium is a flattened cornucopia-shaped structure. The holotype, which is the largest of the specimens, is 45 mm. long; 15 mm. wide at the distal end, 4 mm. wide at the proximal extremity; 2.5 mm. thick at midlength. Articulating process not preserved. Acutely elliptical in cross section. Surface marked by conspicuous straight or undulating annular ridges. Ridges sharp at summits and regularly spaced. Measuring along the central portion of the zoarium of the holotype four appear in 7 mm. at larger end, four in 6 mm. at midlength, and four in 5 mm. at the smaller end. There is no tendency for the ridges to branch nor are secondary ridges intercalated. Intermonticular spaces twice as wide as the monticules. In these interspaces as well as on the sloping sides of the monticules are situated the zooecia, but they do not appear to be set in sloping areas, a feature emphasized in the generic description.



FIGS. *1–4—Escharopora hogbeni* Fritz, n. sp. Holotype. *1*, Transverse section, ×15. *2*, Zoarium, ×1. *3, 4*, Tangential sections, ×15.

Tangential section.—Satisfactory tangential sections have been difficult to obtain owing to the uneven nature of the surface. The first section described here (fig. 3),

prepared from the holotype, is taken from the concave area between two ridges. The zooecia are subpolygonal and irregular in size with an average of eight in 2 mm. They are separated particularly in the central portion of the troughlike depression by a few angular mesopores of varying sizes. Walls of zooecia are only moderately thick.

A second section (fig. 4) from the same specimen represents the summit of a monticule. Here a curved line, the crest of the ridge, composed of calcareous tissue similar in nature to that of the walls, traverses the section. The zooecia on either side of it are more regular in form and arrangement than in the intermonticular space, and few interstitial tubes are observed.

Transverse section.—One very fine section taken at midlength across the holotype cuts the tubes longitudinally. The bifoliate nature of the colony is well demonstrated, in fact, the two halves have split neatly along the position occupied by the median lamella. On either side of this fracture a row of small initial tubes (10 in 1 mm.) are developed. An arrangement noted as somewhat typical shows a larger pentagonal or hexagonal tube in line with the vertical zooecial walls and occasionally a smaller quadrate tube in line with the central portion of the zooecia. The tubes proceed in an almost direct manner to the surface. In the immediate vicinity of the above-mentioned primary tubes the zooecial walls are thin, but a moderate thickening soon develops, which maintains throughout most of their length. At the place where this particular section was cut interstitial cells are not conspicuous. Hemisepta are present in certain tubes, more especially in the basal portion. Complete diaphragms are developed as well, these structures being more abundant in the peripheral zone, where they are a tube diameter or less apart.

The closest relative of *E. hogbeni* would seem to be *E. hilli* from the Maysville group of Kentucky. In form and general anatomical features the two species are very similar. No marked rhomboidal arrangement of the zooecia, however, is observed in the present species.

In studying this new species the writer has had the privilege of examining sections prepared from a typical example of *E. hilli* kindly presented to the Royal Ontario Museum by Dr. R. S. Bassler. A comparison of these sections with those from the Hull specimen shows that *E. hogbeni* differs considerably in the detail of internal structure. For instance, the zooecial walls are much thinner and not as distinctly laminated; the apertures are subpolygonal and not oval; diaphragms are numerous, whereas in *E. hilli* they appear to be absent, and hemisepta are more prominent.

Types.—Holotype, no. 5098, Geol. Survey collections, Ottawa, Canada, microscopic slides 5098 a–c. Paratypes, private collection of G. Winston Sinclair, Ottawa, Canada.

Horizon.—Middle Ordovician, Hull beds, of Trenton age.

Locality.—Hull, Quebec, Canada.

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MANUSCRIPT RECEIVED JUNE 17, 1943.

JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 3, PP. 265–267, 1 TEXT FIG., MAY 1944

A RHINOCEROS TOOTH FROM THE CLARNO EOCENE OF OREGON

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ABSTRACT—A second lower premolar of the rhinoceros genus *Hyrachyus* indicates a middle Eocene age for the Clarno formation of Oregon. The tooth seems to be more like those from the lower than those from the upper Bridgerian (=middle Eocene). This is the first hyrachyid recorded in the United States outside of the Rocky Mountain area. Other teeth are known from China.

THE ONLY known fossil mammal tooth (fig. 1) from the Clarno formation of Oregon is a rhinoceros second lower premolar, which was discovered near the Clarno Bridge on the east side of the John Day River, SE ¼, sec. 27, T. 7 S., R. 19 E., in Wheeler County, Oregon (U. C. Loc. No. V4203). The specimen was found in a tuffaceous matrix bearing crystals of pyroxine and feldspar; many poorly preserved plants were also present. It was found by Mr. A. W. Hancock of Portland, Oregon, in September 1942 and presented to the University of California Museum of Paleontology for description and preservation.

The Clarno formation was first described by John C. Merriam before the Cordilleran Section of the Geological Society of America on December 28, 1900 (see abstract Nov. 27, 1901). A fuller account with a slightly different title, was published in the University of California Bulletin of the Department of Geology in April 1901. On an examination of the plants obtained by Merriam, F. H. Knowlton concluded that the specimens from Cherry Creek (lower Clarno) are lower Eocene and those from Bridge Creek (upper Clarno) are upper Eocene. A greater distinction between the lower and upper Clarno was first suggested by Chaney (1922) when he stated that the upper Clarno formation was probably Oligocene rather than Eocene. Knowlton (1926) directed attention to Chaney's paper but with additional information at hand chose to place the upper Clarno in the lower Miocene. This was followed by Chaney's 1927 report when he described the Bridge Creek flora of the Crooked River Basin in the lower John Day beds; at that time he called it upper Oligocene, but he stated that the (lower) Clarno flora "may be as young as lower Oligocene." This correlation evidently was followed by J. P. Buwalda (1928), but in 1932 Chaney referred the (lower) Clarno to the middle or upper Eocene, then again in 1938 he speaks of "Clarno formation with a subtropical flora—upper Eocene."

The rhinoceros tooth, *Hyrachyus* sp., offers additional information on the age of

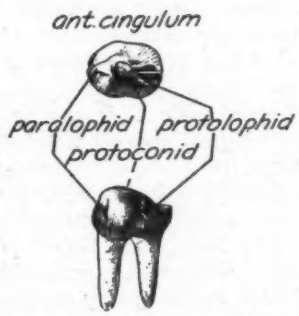

FIG. 1.—*Hyrachyus* sp. Right P_3, occlusal and lingual views, ×1. Univ. California Pal. No. 37078. Drawings by Owen J. Poe.

the Clarno, and though the evidence afforded by a single tooth of this kind is not as conclusive as one would wish it does seem to correspond to the early middle Eocene stage of progression in the Hyrachyidae. The known geologic range of the family (Wood 1934, p. 187) extends from the Lost Cabin, upper Wasatchian (=late lower Eocene) to the Wagonhound B, middle Uintan (=middle upper Eocene). This evidence, then, would seem to clearly place the Clarno within the Eocene. The majority of these hyrachyid species occur in the middle

Eocene; only one has been discovered in the lower and two in the upper Eocene. Unfortunately, most of the diagnostic characters of the genus *Hyrachyus* are based on upper teeth, thus making a specific identification of this specimen difficult. The measurements and shape of the tooth at hand do not exactly coincide with any known species, though the size and shape is more like that in specimens from the early Bridgerian and late Wasatchian. It may represent a distinct species with relatively short and wide premolars but bearing nearer relationships to one of the older species of *Hyrachyus*.

Wood (1934, p. 256) states that the Hyrachyidae are known "only from the states of Wyoming, Utah, Colorado and Montana" in North America. This, then, is the first specimen recorded outside of the Rocky Mountain area on this continent. The only other fossils referable to this family are those described by Zdansky (1930) from Honan, China, as Isectolophinae?, gen. et sp. indet., which Wood (1934, p. 188, footnote) considers as inseparable from *Hyrachyus*.

Short simple robust premolars like the Clarno tooth are characteristic of the Hyrachyidae. A tiny appressed area on the anterior end clearly indicates that another tooth (P_1) in the series occurred in front of this one. The most characteristic feature of the tooth is its relatively short and wide proportions. The only comparable tooth in this respect is that of *H.* cf. *H. modestus* (Wood; A.M.N.H., No. 17442) from the Huerfano of eastern Colorado, but it is smaller than the specimen at hand. The height of the protoconid cannot be measured because of occulusal wear. On the whole, however, the tooth seems less trenchant than in most of the species, and the enamel surface is crenulated. There is a faint cingulum on the anterolabial corner; this is in part conjoined with the paralophid, which is deflected lingually. The protolophid[1] has less lingual and more posterior direction than in *H. modestus* (Leidy) but extends to the posterolingual corner of the tooth. There is no trace of a metaconid or an entoconid. The hypoconid[2] blade, though somewhat worn, shows some indication of being elevated posteriorly in the position of the hypoconid.

As stated above, the Clarno *Hyrachyus* P_2 seems more closely related to the middle Eocene species than to those from the upper Eocene. The talonid is not as progressive as in *H. grandis* Peterson (Carnegie Mus. no. 2908) or *H. douglassi* Wood (Carnegie Mus. No. 784) from the Uinta and Sage Creek faunas. In these upper Eocene species the talonid of P_2 is more attenuate, the protoconid is relatively larger, and the tooth as a whole is more elongate; and this is true to a certain degree in late middle Eocene species.

Comparative measurements with other species of *Hyrachyus* may be found in Wood's Revision of the Hyrachyidae (1934, pp. 284–289).

Hyrachus cf. *H. modestus* (Leidy), U. C. no. 31918, from the Bridger B measures 10.0 mm. in length by 6.9 mm. in width. The tooth of *Hyrachyus* sp. shown in figure 1 measures 10.0 mm. in length by 7.5 mm. in width.

[1] If an attempt is made to homologize the crests on this tooth it seems preferable to call this structure the *protolophid* since it appears to be a lingual outgrowth from the protoconid. *Metalophid* seems more appropriately applied to the lophid that extends anterolingually in the direction of the metaconid on permanent teeth, just as the *paralophid* for the most part is an outgrowth of the protoconid (see Stirton 1941, fig. 4). The anterior extension of the hypoconid blade might be the metalophid on the Clarno tooth.

[2] Hypoconulid blade of Wood 1934.

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 3, PP. 268–270, PLS. 42, 43, MAY 1944

HALYSITES GRACILIS FROM THE ORDOVICIAN OF MANITOBA

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ABSTRACT—Coralla of *Halysites gracilis* with the corallites arranged in single series, in more than one series or grouped together in compact masses so that these parts resemble a *Favosites* are described. This unusual arrangement of the corallites probably represents only an aberrant development. Very large coralla are also described.

THE CHAIN coral *Halysites gracilis* (Hall) is a very common coral in the Selkirk member of the Red River formation (Upper Ordovician) of Manitoba. This species was first recognized in Manitoba by Whiteaves (1880), who listed it as *H. catenularia* Linnaeus. At Garson, where the Selkirk outcrops in several quarries, many beautifully preserved specimens of *H. gracilis* have been collected, and they form the basis for the present study. The species also occurs in the Dog Head and Cat Head members of the Red River formation. Many of the coral species found in the Selkirk also occur in the overlying Stony Mountain formation of Richmond age. The absence of *H. gracilis* in the Stony Mountain is somewhat surprising, since it is so abundant in the Selkirk.

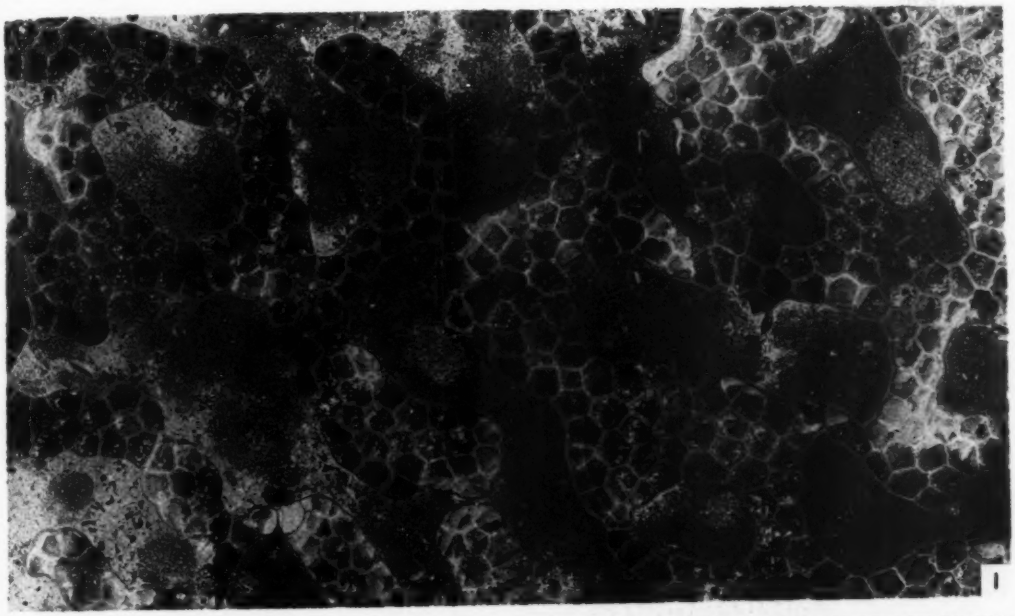
For many years the Red River formation was correlated with the Galena (Trenton). Foerste (1929) pointed out that *H. gracilis*, along with other corals, suggests a Richmond rather than a Trenton age for the Red River. This species also occurs in the Stewartville formation of the upper Mississippi valley. According to Kay (1935) the fauna of the Stewartville is similar to that of the Red River. Kay, however, considers the Stewartville to be of Middle Ordovician age.

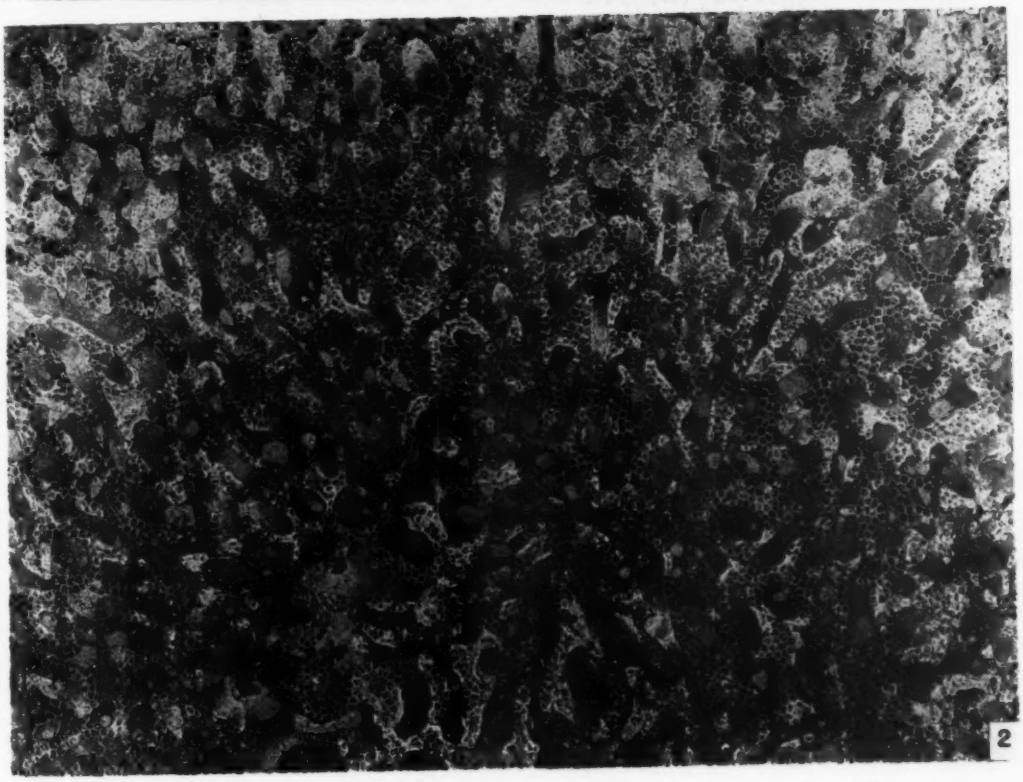
One of the remarkable features of *H. gracilis* in Manitoba is the very large size of corallum attained by several specimens collected at Garson. I am greatly indebted to the Manitoba Museum Association for permission to describe and illustrate their specimen (see plate 43, fig. 1) of an unusually large corallum of this species from Garson. Its dimensions are 22 inches (558.8 mm.) by 14.5 inches (368.3 mm.). Unfortunately the corallum is shown only on the polished surface of a building stone, and its height can not be determined. A fragment of a very large corallum in the University of Manitoba collections (specimen number 107), which is incomplete at the upper and lower ends, has a height of approximately 11 inches (279.4 mm.).

Although it has been recognized that there is considerable variation within *Halysites* Fischer, the genus has been characterized as having the corallites "arranged in a single series" (Milne-Edwards and Haime, 1850) or "joined to one another only along the more restricted edges" (Zittel-Eastman, 1913) or "joined to each other along the more constricted edges" (Twenhofel and Shrock, 1935). Twenhofel (1928) described, but did not illustrate, a specimen of *H. catenularia* from the Silurian beds at Cape

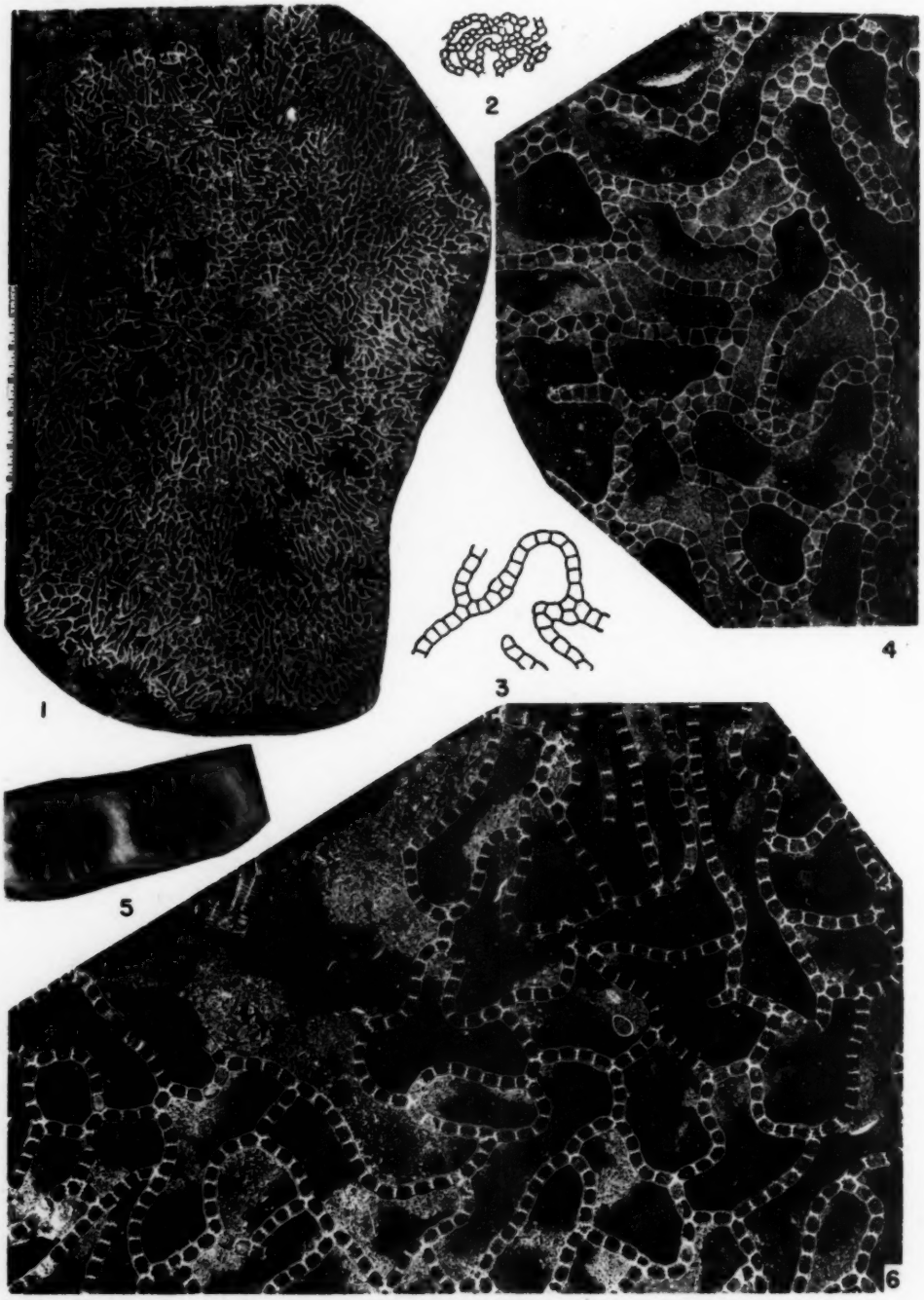
EXPLANATION OF PLATE 42

FIGS. *1–2*—*Halysites gracilis* (Hall). Photographs in the University of Manitoba geological collections of a building stone quarried from the Selkirk member of the Red River formation at Garson, Manitoba. Photographed by Mr. H. Whimster under the direction of the late Dr. S. R. Kirk. *1*, Part of the corallum ×2 showing corallites arranged in more than one series and grouped together in compact masses. *2*, Part of a much larger photograph which shows, in section, a corallum covering an area of approximately 15 inches by 16 inches on the polished surface of the stone. Scale on original photograph indicates ×½ for this view. (p. 269)





Leith, *Halysites gracilis* (Hall)



Leith, *Halysites gracilis* (Hall)

MacGilvray, Anticosti, in which certain parts of the corallum have the appearance of a *Favosites*. Lambe (1899) illustrated specimens of *H. catenularia gracilis* (=*H. gracilis*) from Manitoba in which the corallites are arranged in double rows. It is surprising to find that in his description of the species he did not comment on this feature. His figures are reproduced on plate 43. This unique variation of *Halysites* is very rare and apparently, to judge by the written descriptions of the genus, it is not a well-known one. The writer has been very fortunate in having available for study excellent material and photographs that show a remarkable development of this particular variation in *Halysites*.

In Manitoba the majority of specimens of *H. gracilis* have the corallites arranged in a single row or series, and this, the normal type, is illustrated as figure 6 on plate 43. The specimen used for this photograph also shows the well-developed septal spines, the quadrangular and suboval outline of the corallites, and the wide and narrow irregular reticulations A few specimens, however, show a very unique arrangement of the corallites for a *Halysites*. Single, double, and triple rows or series of corallites occur within the same corallum, and in many places a compact mass of corallites is developed, so that in such parts the corallum resembles a *Favosites*. The outline of the corallites in these specimens varies from quadrangular, trapezoid, triangular, to hexagonal. The hexagonal outline of the corallites in the favositidlike areas appears to be the result of very close crowding and compaction of the corralites into the smallest possible space. In all probability this unusual structure for a *Halysites* developed from multiple budding or fission of the corallites and their growth in restricted areas rather than their formation into spreading stolons. The wide irregular reticulations are just as characteristic of these specimens as they are of the normal type of *H. gracilis*. All of the features just described are illustrated on the accompanying plates 42 and 43.

The specimens described above and illustrated on the plates are not considered by the writer to represent a new species of *Halysites* or even a variety of *H. gracilis*. The unique structure shown by the Manitoba specimens appears to be the result of aberrant development of the corallites in coralla of *H. gracilis*. In the very large specimen illustrated on plate 42 about 90 percent of the corallum is composed of corallites arranged in a single series. If such a corallum had been broken up into a number of small pieces, so that in collecting specimens one did not know or realize that the pieces belonged to the same individual, the majority of the pieces would be identified as *H. gracilis* and a new name or variety of *H. gracilis* might be proposed for the fragments with the favositidlike areas and corallites arranged in more than one series. For example, consider the specimen illustrated as the normal type. It might possibly be a fragment of a very large corallum in which favositidlike areas and double rows of corallites developed in certain parts. This, however, can not be determined from the fragment itself. On first examination one might be inclined or strongly tempted to propose a new species for the specimen illustrated on plate 42. It is, the writer believes, a specimen with only an extreme development of the aberrant type of *H. gracilis* with very few chains in which the corallites are arranged in a single series. A specimen intermediate in type between the extreme and normal is illustrated as figure 4 on plate 43. It should also be kept in mind that the favositidlike

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EXPLANATION OF PLATE 43

All the specimens illustrated, except 2 and 3, are from the Selkirk member of the Red River formation at Garson, Manitoba.

FIGS. *1–6*—*Halysites gracilis* (Hall). *1*, Large corallum, length of scale 6¼ inches, ×0.18 (Manitoba Museum 490). *2*, *3*, Parts of coralla illustrated by Lambe. *4*, Part of corallum with corallites arranged in more than one series, ×1.5 (Univ. of Manitoba 108). *5*, *6*, Two corallites ×3.5 to show needlelike septa and normal type of corallum ×1 (Univ. of Manitoba 109). (p. 269)

structure is developed in the specimen of another species, namely *H. catenularia*, described by Twenhofel. The writer, therefore, does not think it advisable, at the present time, to introduce a new name for these specimens.

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 3, PP. 271–274, 8 TEXT FIGS., MAY 1944

AN AMEBELODON FROM MALHEUR COUNTY, OREGON

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A PREDICTION made in 1941 by Barbour and Hibbard that "many other species of the amebelodonts and platybelodonts are sure to be found and published" can be partly fulfilled, for it is now possible to extend the range of the amebelodonts from Nebraska, Kansas, and Colorado to include eastern Oregon.

The specimen which forms the basis of this paper was loaned to the author by Dr. R. L. Lupher of the Department of Geology of the State College of Washington at Pullman. It has the catalogue number 2084 of their collection.

The circumstances of the discovery and the location are given by Dr. Lupher.

> The fossils were discovered by Mr. Sam Ross of Jordan Valley, Oregon. He removed the mandibles and teeth. I visited the locality in 1935 and recovered additional bone materials. The locality lies at the north end of the antelope reservoir, about seven miles southwest of Jordan Valley. Waves, at the highest level of the water, have locally removed the cover of soil and sagebrush on a gentle swell in the extensive flats that border the reservoir. The fossils were imbedded in a grayish-buff massive siltstone.

It may be assumed, until further evidence is at hand, that the formation from which the specimen was excavated is of middle Pliocene age. This assumption is based upon the fact that all other specimens of *Amebelodon* have come from the middle Pliocene or from beds suspected to be of that age. Beds of middle Pliocene age are reported southwest of the locality in the vicinity of Rome, Oregon (Wilson, R. W., 1938). No more definite correlation can be attempted until further knowledge is obtained of the fauna and the geology.

The material recovered consists of the incomplete right (fig. 7) and left (fig. 6) rami of the lower jaw, an incomplete M^3 (fig. 2), atlas (fig. 1), axis (fig. 8), pelvis (fig. 5), and several fragments of skull, vertebrae, and limb bones. The left is the more complete of the two mandibular rami. Both mandibular tusks are missing, as well as the symphyseal region. The plaster reconstruction was made by Dr. Lupher before the specimens were loaned to the author.

It is not felt advisable at this time to assign the specimen to a definite species, because the teeth are incomplete and the tusks are lacking. It appears, however, to be very closely related to *Amebelodon* (*Trilophodon*) *hicksi* Cook (1922). It is to be hoped that other more complete specimens will be found in southeastern Oregon so that a more specific determination may be made.

The left ramus appears to be about three-fourths complete. The outline of the lower jaw agrees closely with that of other species of *Amebelodon*. Unfortunately, the coronoid process is broken, so it is impossible to tell whether or not it was higher than the condyloid process. The mandibular tusks are missing, and there is not enough of their alveoli remaining to prepare a cast.

A rudimentary hexalophid, complete pentalophid, tetartolophid, and a part of the trilophid on M^3 serve to identify the specimen as *Amebelodon* sp. Vestiges of a heavy cingulum with very prominent conules are apparent on both upper and lower molars.

Measurements

	Mm.
M_3—Anteroposterior	222 ±
Height of crown	60
Width at base	90
Width at crown	60 ±
M^3—Width at tetartoloph	90
Height of crown at tetartoloph	50
Anteroposterior length of axis, through odontoid process	131
Anteroposterior length of atlas	9
Height of atlas	20

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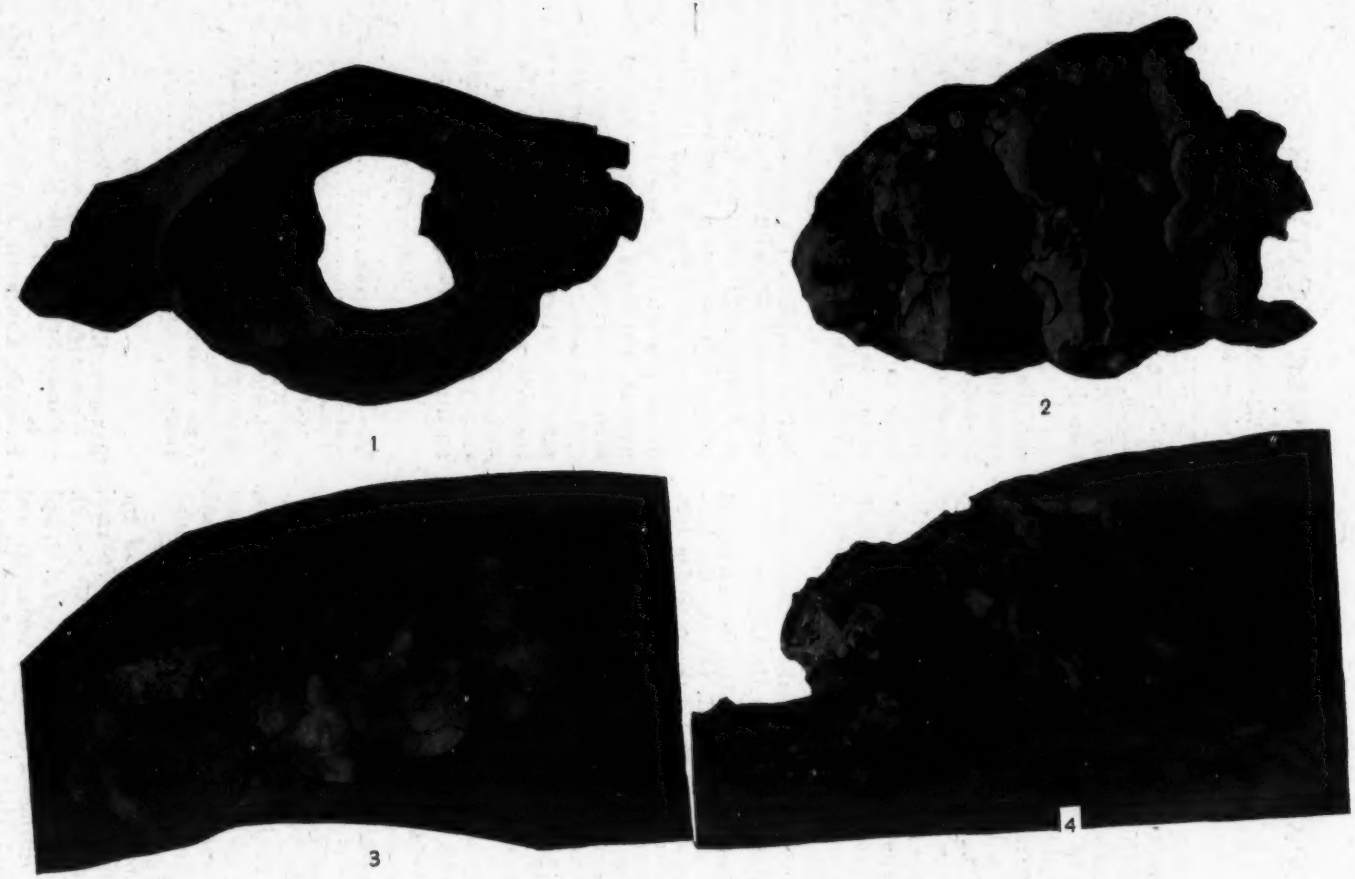

FIGS. *1–4—Amebelodon* sp. *1*, Atlas, ×¼; *2*, left M^3, ×½; *3*, right M_3, ×½; *4*, left M_3, ×½.

FIGS. *5–8*—*Amebelodon* sp. *5*, Pelvis, $\times\frac{1}{8}$; *6*, left ramus lower jaw, $\times\frac{1}{8}$; *7*, right ramus lower jaw, $\times\frac{1}{8}$; *8*, axis, $\times\frac{1}{8}$.

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 3, PP. 275–282, 2 TEXT FIGS., MAY 1944

PROLOCULUS IN FORAMINIFERA

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ABSTRACT—As the word proloculum was incorrectly formed, it is recommended that *proloculus* be adopted and that scientists set up a norm of procedure for coining terms in the future. The proloculus of the Foraminifera may be simple, double, or complex. In megalospheric adults, such as in *Lepidocyclina*, the parts of the complex proloculus may be called the deuteroconch and heteroconch. Ideas concerning the shape, size, and origin of the proloculus are recorded, and several reasons for attaching significance to the proloculus are enumerated.

INTRODUCTION

SPECIALISTS are giving detailed attention to the ontogenetic stages of the Foraminifera, but the workers concerned with one group of these protozoans sometimes fail to take into account the morphologic terminology adopted by their colleagues. Although the array of terms bewilders inexperienced workers and at times puzzles experienced ones, little effort has been directed towards simplification. Indeed, with notably rare exceptions, no one has inquired into the appropriateness of terms in current literature. For example, juvenarium, nepiont, embryonic apparatus, and nucleoconch are employed by different writers in the same sense, whereas protoconch has been used in different senses. The following discussion directs attention to the first-formed chamber of the foraminiferal test, its nomenclature and significance.

TERMINOLOGY

Terminology prior to 1905.—Carpenter (1856) referred to the central chamber as the "nucleus," the quotation marks indicating his knowledge that the word was inappropriate. Later, Carpenter (1862, p. 77) described the decalcification of living "*Miliola*" and termed the first-formed protoplasmic division the primordial segment. The central chamber was spoken of throughout this work as the primordial chamber. Munier-Chalmas and Schlumberger (1885, p. 276) coined the convenient terms *megasphere* and *microsphere* in order to refer to the relatively large and small initial chambers of dimorphic species. *Embryonalkammer* was the word adopted by Rhumbler (1894, 1902). A large number of other expressions, such as primordium and central chamber, have been used informally by various writers. The informality permitted freedom of speech, loose descriptions, and later misunderstanding.

Proposal of proloculum in 1905.—Cushman (1905, p. 538) formally proposed the term *proloculum* in the following manner:

> The initial chamber which will be shown to have a decidedly phylogenetic bearing in the group is here given a distinctive name—the *proloculum*—to correspond with the term applied to the embryonic shell of other groups already worked out in the Metazoa.

Proloculus better form than proloculum.—In 1935, Arthur Earland pointed out to Earl H. Myers that the word proloculum was incorrectly formed. Hans E. Thalmann likewise disapproved of the spelling. As the writer has been preparing notes on the variations of the fossil Foraminifera with particular emphasis on stages of growth, it seemed to him appropriate to indicate the reasons why the word proloculus is preferable to proloculum. Accordingly, Raymond D. Harriman, Professor of Classics at Stanford University, was requested to give this matter his attention and he has kindly prepared the following statement:

> The term *proloculum* was apparently formed from the noun *locus* (place, spot) by the use of (a) the diminutive suffix *-ulus, -a, -um* and (b) the prefix *pro*. Two criticisms might be made of this term whether by a classicist interested in the derivational procedure in classical Latin or by a scientist interested in having and maintaining a norm of derivational procedure in the biological sciences.
>
> (a) Since *locus* is of masculine gender, its diminutive should be of the same gender, hence *loculus*.

(b) *Pro-* is prefixed primarily to verb stems. When prefixed to nouns, it is used as a preposition and not as an adjective except in words of relationship, such as *proavus* (=fore-grandfather, great-grandfather). Thus, with *fanum* (=shrine), it forms an adjective *profanus, -a, -un* (=before the shrine or temple, outside of it, hence unholy), or from the phrase *pro consule* (=in place of the consul) arises the compound *proconsul*. *Pro-* does not have the meaning "rudimentary" as implied in the description of the chamber as "primordial" by Carpenter.

Although it may be inadvisable to correct all of the linguistic *faux pas* perpetuated by biologists in the past, it does seem sensible to attempt to evolve norms of derivational procedure for future use whenever possible.

To sum up, the word proloculum was incorrectly formed from the Latin; the spelling should have been *proloculus*. It is recommended that the corrected spelling be adopted. Although this recommendation does not imply that all incorrectly formed technical terms should be corrected, it does imply that coiners of terms might well set up norms for procedure.

Terms proposed after 1905.—Among the terms employed since 1905 in describing the early stages of Foraminifera is *protoconch*, which was used by L. M. Davies (1932, p. 407, etc.; 1937, p. 53, etc.) as an absolute synonym of proloculus. Tan (1937) and Brönnimann (1940) used protoconch for the supposedly initial chamber in the "embryonic apparatus" in some of the Tertiary foraminifers. No doubt the expression was designed to parallel *deuteroconch*, which is the presumed second chamber to be formed. Hofker (1927) had previously adopted *megalosphere* for what Tan and Brönnimann call the protoconch. Grabau (Amer. Nat., vol. 36, 1902) and many others have used protoconch for the first-formed shell of the gastropods. In view of the fact that protoconch has so many meanings and also since it is possible that in some Recent species the so-called protoconch is formed after the deuteroconch, it seems advisable to abandon protoconch as a morphologic term in the Foraminifera. *Heteroconch* might be adopted instead for the protoconch of Tan, Brönnimann, and others; it is impressive and descriptive enough to be a partner expression of deuteroconch.

DOUBLE PROLOCULUS

Staff (1910) gave a detailed, illustrated report on the morphology of certain fusulinid Foraminifera, recognizing that occasionally megalospheric forms have double proloculi. He expressed a number of ideas regarding the physical-chemical conditions controlling the character of the proloculus. Dunbar and Henbest (1942) have figured a Paleozoic specimen with two proloculi, each of which they say is surrounded by about one volution of chambers coiled about itself without interference by its twin. They were uncertain whether the "twins" were members of a single brood or whether fusion was possible between individuals of the same age.

Earl H. Myers (personal communication, June 1943) has taken a photomicrograph of a stained and decalcified Recent specimen of *Elphidium* having a double proloculus. Noteworthy is the presence in this individual of two nuclei. As he has seen this condition in other species, he has formulated the following explanation:

Because of the close proximity of megalospheric juveniles during early developmental stages, two or more of the amoebulae occasionally fuse to produce an unusually large amoebula. A megalospheric foraminifer produced in this manner often contains an unusually large proloculus and two or more nuclei. Should the juveniles fuse at a later stage of development, the resulting test will contain two or more proloculi and a like number of nuclei. When this takes place, an otherwise normal test may result, or each juvenile may attempt to develop independently, in which case the test may have two or more keels.

COMPLEX PROLOCULUS

Students of the orbitoids and allied foraminifers have recognized that it is sometimes difficult to determine which part of the central chambers were formed first in the megalospheric generation. That is to say, doubt exists as to which chamber should be called the proloculus. A number of descriptive terms arose as a consequence. One of the expressions is "apparato embrionale" of Silvestri (1907)—embryonic apparatus. Checchia-Rispoli (1913) used "apparecchio embrionale." Several writers have adopted "nucléoconque"—nucleoconch—as introduced by Douvillé (1915, p. 665). Henbest

(1934) proposed "juvenarium" for "a stage of shell building"; this becomes by derivation the young stage. It might be remarked here that in the orbitoids one is not always certain just when youth ends and maturity begins: If the periembryonic chambers are excluded from the juvenarium, then the term complex (or compound) proloculus is a synonym of juvenarium and proloculus would replace heteroconch. Tan (1939, p. 93) used the expression "initial apparatus" for the "protoconch+deuteroconch." Still another term, nepiont, has been used by Tan, Rutten (1941, p. 50), and others.

So it is that present-day specialists dealing with the morphology of the larger Cretaceous, Tertiary, and Recent foraminifers may draw upon many technical expressions —primordium, protoconch, deuteroconch, nepiont, juvenarium, embryonic apparatus, initial apparatus, nucleoconch, and others. Fine distinctions might be drawn between seemingly synonymous words; for example, one might hold that the embryonic apparatus is a general descriptive term for both chambers and walls, whereas only the actual wall which surrounds the embryonic chambers should be designated the nucleoconch. Whatever the expression adopted for these central chambers in the megalospheric adults of such genera as *Orbitoides*, *Lepidocyclina*, and *Miogypsina*, it is manifest that some part of the "embryonic apparatus" is the initial chamber, but that the two or more divisions, commonly surrounded by a thick wall, constitute a unity, comparable to the simple proloculus.

SHAPE OF PROLOCULUS

The subject of the shape of cells is admirably reviewed by Gray (1931, pp. 248–266) and Thompson (1942). That "each living cell must, when isolated from its neighbours, naturally assume a spherical state" is the conclusion drawn by Gray (1931, p. 251) from experiments conducted by Roux in 1897. This conclusion is accepted by many biologists. Since a mechanistic explanation is adequate to account for the shape of the simple proloculus, further discussion of the sphere is not needed here.

The shape of the complex or compound proloculus (the nepiont, embryonic apparatus, etc.), however, is not easily explained. Douvillé (1915) noted the similarity between the quadricellular complex proloculus of *Orbitoides* and the tetrad of the liverwort "*Fegatella*" (fig. 1). One may also note the analogy between drops of oil and the proloculi (juvenaria, etc.) of *Lepidocyclina* and *Nephrolepidina* (fig. 1). Coincidences of this nature may have little biological significance, but some scientists have confidence in the physical-chemical control of form.

That the complex proloculus (juvenarium, embryonic apparatus, etc.), such as in *Nephrolepidina*, will differ according to the direction of the plane of the section cutting it has been shown by Schenck and Aguerrevere (1926). E. H. Myers (personal communication, June 1943) finds that in sectioning megalospheric tests of *Tinoporus* five types of figures result, depending upon which spine or which tangent between the two spines is uppermost. For example, when spine 1 or 4 is in a vertical position, sections of the complex proloculus will show a simple sphere first, and then the sphere partially embraced by a larger, elliptical chamber. Other sections show the proloculus consisting of three tangential spheres.

Illustrations of the early chambers in *Tinoporus*, based on drawings by Myers, are given in figure 1. At the time when the figures were prepared, Myers was of the opinion that the larger chamber ("A") was formed first, the smaller ("B") later. Nevertheless, his attempts to prove which of the first two chambers is the proloculus have failed, since this stage is contained within brood chambers and when the material is sectioned it is difficult to recognize which chamber one is dealing with.

SIZE

What is the maximum size of the proloculus in the Foraminifera? Figure 2 is a preliminary attempt to compile information which may serve as a basis for answering this and other questions. Each numbered spot on the graph represents the measurements of one or more specimens of the species named in the explanation of the figure, according to the authority cited. The spots are plotted on semilogarithmic paper in order to condense the graph to a convenient size. The quality of the data is variable; for example, one spot may represent the maxi-

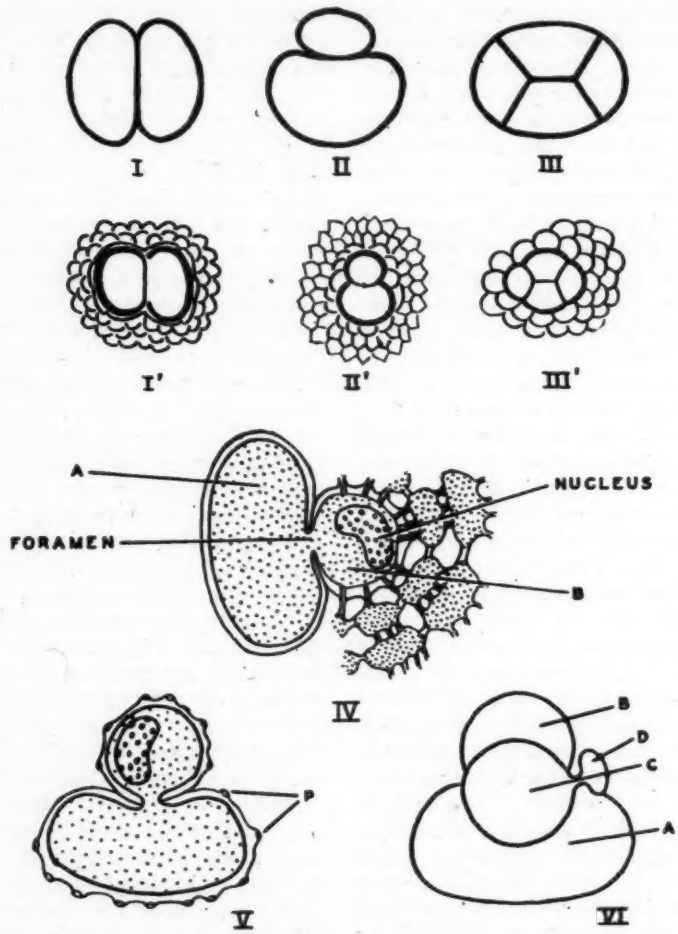

FIG. 1—I, Oil drops mutually compressed against each other, from Gray (1931), after Roux. I', *Lepidocyclina, sensu stricto*, after schematic section in Rutten (1941). II, Oil drops mutually compressed against each other, from Gray (1931), after Roux; calcium acetate on surface of drop prevents fusion with contiguous drops. II', *Nephrolepidina*, after Rutten (1941). III, Schematic representation, simplified, of segmentation of spore of "*Fegatella*," after Farmer in Douvillé (1915), nuclei omitted. III', *Orbitoides tissoti*, from Douvillé (1915). IV, Simplified diagram from detailed drawing by E. H. Myers of *Tinoporus*. Chamber "A" was probably the first one to form, "B" the second; note nucleus in chamber "B"; chambers in one cycle communicate with chambers of adjacent cycle by pseudopodial pores; chamberlets in same cycle communicate by stolons. V, Diagram from detailed drawing by Myers of *Tinoporus;* the letter "p" indicates the pseudopodial pores. VI, Diagram by Myers to show the first ("A"), second ("B"), third ("C") chambers and first chamberlet ("D") of *Tinoporus*.

mum dimensions of many specimens, whereas no. 23 is the measurement of one test only. If an author from whom the data were compiled gave dimensions of both the megalospheric and microspheric tests and proloculi of one species, the two numbers indicate that fact. Also, if an author gave many measurements for a species, the spot represents maximum size of proloculus and length of test.

Examination of the graph suggests several inferences, which are listed here in order that they may be tested by workers handling many different kinds of foraminifers. The

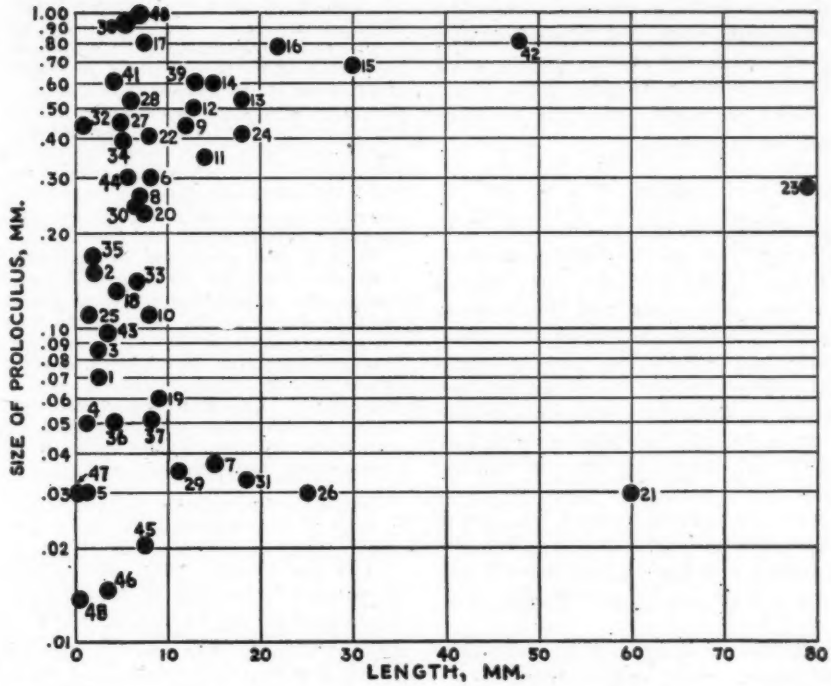

FIG. 2—Size of foraminiferal test plotted against size of proloculus for the following species: 1, *Ozawainella huecoensis* Dunbar & Skinner; 2, *Ozawainella delawarensis* Dunbar & Skinner; 3, *Leëlla bellula* Dunbar & Skinner; 4, *Codonofusiella paradoxica* Dunbar & Skinner; 5, *Schubertella kingi* Dunbar & Skinner; 6, *Triticites pinguis* Dunbar & Skinner; 7. *Schwagerina huecoensis* Dunbar & Skinner; 8, *Pseudoschwagerina beedei* Dunbar & Skinner; 9, *Pseudoschwagerina gerontica* Dunbar & Skinner; 10, *Paraschwagerina kansasensis* Beede & Kniker, from Dunbar & Skinner (1937); 11, *Parafusulina schucherti* Dunbar & Skinner; 12, *Parafusulina diabloensis* Dunbar & Skinner; 13, *Parafusulina bakeri* Dunbar & Skinner; 14, *Parafusulina maleyi* Dunbar & Skinner; 15, *Parafusulina wordensis* Dunbar & Skinner; 16, *Polydiexodina capitanensis* Dunbar & Skinner; 17, *Neoschwagerina megasphaerica* Déprat, after Gubler (1935); 18, *Cycloclypeus* cf. *C. guembelianus*, after Cosijn (1938); 19, *Operculina complanata* (Defrance), after Hofker (1927); 20, *Cycloclypeus openoorthi* Tan (1932); 21, 22, *Cycloclypeus carpenteri* Brady, after Hofker (1927); 23, *Loftusia morgani* Douvillé, specimen in Schenck Collection; 24, *Lepidocyclina californica* Schenck & Childs; 25, *Operculinoides semmesi* Vaughan & Cole; 26, 27, *Spiroclypeus leupoldi* VanderVlerk, after Krijnen (1931); 28, 29, *Spiroclypeus tidoenganensis* VanderVlerk, after Krijnen (1931); 30, 31, "*Alveolina*" *boscii* Defrance, after Chapman (1908); 32, *Idalina antiqua* (d'Orbigny), after Munier-Chalmas & Schlumberger (1885); 33, "*Alveolina*" *vredenburgi* L. M. Davies (1937); 34, *Nummulites lamarcki* d'Archiac, after de la Harpe (1881), measured on illustration; 35, 36, *Pellatispira orbitoidea* Provale, after Umbgrove (1928); 37, *Lepidocyclina waylandvaughani* Cole (1928); 38, *Lepidocyclina meinzeri* Vaughan (1933); 39, *Lepidocyclina forresti* Vaughan (1927); 40, *Nummulites vasseuri* Douvillé, after Flandrin & Jacquet (1936); 41, *Nummulites tchiatcheffi* d'Archiac, after Flandrin & Jacquet (1936); 42, *Nummulites ehrenbergi* de la Harpe (1883), measured from figure; 43, *Operculina heterosteginoides* Hofker (1933); see also No. 46; 44, 45, "*Orthrophragmina*" *advena* Cushman, after Hofker (1932); 46, *Operculina heterosteginoides* Hofker, microspheric form of No. 43; 47, 48, *Spiroplectammina sagittula* (Defrance), after Hofker (1930).

statements are put into dogmatic language here merely for the sake of simplicity of exposition, not because they are held to be more than hypotheses:

First, the proloculus of the Foraminifera does not exceed a diameter of 1 millimeter.

Second, the proloculus may be as small as 4 microns, but no smaller.

Third, no correlation exists between the size of the proloculus and the systematic place of the particular species in the order Foraminifera. Some specimens of the Fusulinidae have as large proloculi as some orbitoids, for example.

ORIGIN

Myers (1935, 1936) proved that in *Patellina corrugata* the microspheric proloculus originated as a bud formed at one side of the postzygotic amoebula after the divisions of the zygotic nucleus. Several nuclear divisions may take place before the proloculus develops. The size of the proloculus is independent of the diameter of the amoebula or its contained nuclei. The megalospheric proloculus of all species so far studied by Myers develops around a mass of protoplasm enclosing a single nucleus. The size of the megalospheric proloculus is influenced by the diameter of the nucleus but not necessarily by the amount of surrounding cytoplasm.

The complex (or compound) proloculus—or juvenarium, embryonic apparatus, nucleoconch, whichever the reader prefers—of the orbitoids and similar Foraminifera is difficult to explain. The suggestions put forth by Douvillé (1915) have already been referred to on an earlier page. The *Nephrolepidina* type of structure, where one chamber partially surrounds another, is similar to the arrangement in *Tretomphalus*, a genus studied in detail by Myers (1943), and other modern forms. Myers (personal communication) is inclined to the belief that the "juvenarium" of the orbitoid was produced within a brood chamber, but as he also realizes the difficulties of a definitive explanation, he prepared the following statement for publication here:

> Before considering the origin and significance of the chambers that make up the "juvenarium" of megalospheric tests in extinct Foraminifera, it is necessary to consider the method of development and growth in Recent species:
>
> In the majority of species studied, differentiation and development of the asexually produced generation takes place after the escape of the protoplasmic content of the parent test. Usually multiple fission of the protoplasmic mass results in the production of amoebulae that develop into the megalospheric juveniles, as in *Elphidium* and "*Miliolina*." A more unusual method is for the proloculus of juveniles to develop within the mass of protoplasm prior to multiple fission, as in *Patellina corrugata*.
>
> The term viviparous has been applied to species bringing forth pre-formed juveniles and of these there are two types. First, those in which the juveniles are produced within special brood chambers that develop about the periphery of the parent test, as in *Sorites* and *Tinoporus*. Second, those in which the only modification of the parent test is the solution of the septa between the larger chambers to provide room for the developing juveniles, as in *Discorbis* and *Peneroplis*.
>
> In both viviparous and aviviparous species, with the exception of *Patellina* and related genera, the amoebulae produced through the multiple fission of the protoplasmic content of the parent test consist of a dense, highly granular mass of endoplasm surrounded by a film of less dense, hyaline ectoplasm that gives rise to the pseudopodia. Later, the amoebulae become invested in a chitinous membrane upon which the ectoplasm deposits calcium salts to form the proloculus of megalospheric tests.

SIGNIFICANCE

The main reason why the proloculus is significant is because of its relation to dimorphism in the Foraminifera. Ever since 1880, when Munier-Chalmas announced his conclusion that each species has two forms—one with a large and one with a small proloculus—specialists have appreciated the importance of the proloculus. This is so well known that further discussion is not needed here.

Myers (1943) suggested a correlation between size of proloculus and environment. A study of *Elphidium crispum* showed that the least diameter of the megalospheres living in the sublittoral zone is greater than the mean diameter of the class of those taken from tide pools. Further inquiry is needed to confirm such a correlation.

The proloculus has been used in taxonomy by several workers. The study of *Triticites* by Burma (1942) showed that the size of the proloculus is a useful character in differentiating some species. For example, his figure 13, page 754, makes it clear that *Triticites burgessae* can be separated from *T. plicatulus* by this morphologic feature alone, whereas for the recognition of other species other characters must be employed.

Hofker (1932) measured the diameter of the "appareil embryonnaire" and the number of annuli of chambers seen in horizontal sections of 45 specimens identified as *Discocyclina advena* (Cushman). He affirmed

(p. 211) that there is a remarkable relation between the radial diameter of the chambers and the diameter of the "appareil embryonnarie." His observations, he held, tend to confirm the "law" published in 1911 by Rhumbler to the effect that the diameter of the chambers is a function of the volume of the proloculus.

Cosijn (1938) attached biogenetic importance to the proloculus. He proposed (p. 55) the following hypothesis:

> The foraminiferal proloculum goes through a development that is characterized by a gradual increase of the average volume, on which follows, after a maximum has been reached, a period wherein the reversed evolutional picture is passed through, during which the average volume is gradually reduced.

He found that in certain specimens of *Cycloclypeus* the average size of the proloculus increased with a decrease of geologic age; in *Lepidocyclina tournoueri* he reported a decrease in size with decrease in geologic age. Therefore, he concluded that one can apply the principles of anagenesis and catagenesis to the proloculus of these organisms. Although the hiatus between his facts and his inferences is great, his work has the merit of suggesting lines of inquiry concerning the phylogenetic significance of the proloculus—a suggestion which Tan (1939) reinforced by his observations on some of the larger foraminifers.

Finally, it seems significant that the complex (or compound) proloculus—the embryonic apparatus, juvenarium, nucleoconch, nepiont, or whatever you will—never occurs in individual foraminifers whose growth throughout life is that of a logarithmic spiral. Such a spiral mode of growth has been discussed at length by Thompson (1942).

CONCLUSION

The principal aim of this note has been to induce students of the Foraminifera to assemble more information concerning the proloculus of these organisms. Many additional data are needed, especially dimensions of the proloculi. The origin of the proloculus in megalospheric forms is not satisfactorily determined, except in a few genera. A second purpose of the paper is to urge either a simplification of morphologic terminology or a uniform one; in either event, workers might set up norms for coining new terms. Finally, an effort has been made to show that the proloculus is important and is worth the serious consideration of specialists.

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SOUTH AMERICAN AND EUROPEAN SPECIES OF SPONDYLOSPIRA

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ABSTRACT—Two brachiopod species, previously described by Körner from Triassic (Cassian-Raibl) strata of the Nevado de Acrotambo, northern Peru, have been found to occur also in the region about Cerro de Pasco, central Peru. Both are referred to Cooper's new genus *Spondylospira*, as are five (perhaps even seven) more forms from the Nevado de Acrotambo and "*Spiriferina*" *kössenensis* Zugmayer from the Upper Triassic (Rhaetic) of the northern calcareous Alps of Austria. Also "*Spiriferina*" *steinmanni* Tilmann and "*Spiriferina* sp." Tilmann, both from the Middle Liassic of the Cerro de Pasco region, may be referable to *Spondylospira*.

SOME TIME ago Dr. William F. Jenks, geologist with the Cerro de Pasco Copper Corporation, presented to The American Museum of Natural History an extensive collection of Mesozoic invertebrate fossils. These were collected in the course of geologic investigations in the region about Cerro de Pasco, Peru. Dr. Jenks' studies are supported by a research grant of the American Philosophical Society in Philadelphia.

Among these fossils two species of *Cyrtina*-like brachiopods, represented by 47 and 8 specimens, respectively, prove to be of particular interest. Both were described some years ago by Körner (1937, p. 168, pl. 11, figs. 5–8; p. 168, pl. 11, fig. 4) from Triassic (Cassian-Raibl) strata of the Nevado de Acrotambo, northern Peru, under the name of *Spiriferina acrotamboensis*, n. sp. and *Spiriferina* cf. *canavarica* Tommasi nov. var. *robusta*, respectively.

Both these forms belong to Cooper's recently (1942, p. 232) established genus *Spondylospira*.[1] After examining some of our specimens, Dr. Cooper, whose courtesy is greatly appreciated, verified our generic determinations.

Körner's material included only four dorsal valves of the smaller form. These he believed to be a new variety, *robusta*, of *Spiriferina canavarica* Tommasi, emend. Bittner[2] described from the Muschelkalk of the vicinity of Recoaro, southern Tyrol. However, our specimens, including some dorsal valves with high, perpendicularly striated areas clearly show that this form has nothing in common with Tommasi's. It is here raised to the rank of an independent species, *S. robusta* (Körner).[3]

The conspecificity of both forms from Cerro de Pasco with those published by Körner appears to establish the Cassian-Raibl age of the beds, originally believed by Dr. Jenks[4] to be Jurassic or "probably Jurassic." Both species will be fully described and figured in a future report on the Mesozoic invertebrate fossils from the Cerro de Pasco region.

In addition to the two species of *Spondy-*

[1] In one of our specimens of *S. acrotamboensis* the delthyrium was found to be covered by a thin pseudodeltidium. This pseudodeltidium, which seems to be formed of less resistant material than other parts of the shell, is missing in all but one of the specimens examined (except for traces recognizable in a second). However, originally it seems probably to have been present in all specimens. Should this be correct, it would require a slight modification of Cooper's (*loc. cit.*, "delthyrium open") generic diagnosis.

[2] Tommasi, 1886, p. 214, pl. 3, fig. 21 (*Spiriferina seebachii*); p. 216, pl. 3, fig. 22 (*Spiriferina canavarica*); Bittner, 1890, p. 32, pl. 35, figs. 17–21.

[3] It is unfortunate that, according to the laws of priority, Körner's varietal name has to be kept as the specific name since this form is small and graceful, as compared with the much larger and clumsier *S. acrotamboensis*, with which it is associated in the Cerro de Pasco region.

[4] In a letter, dated Arequipa (Peru), November 20, 1942.

lospira, which have also been found at Cerro de Pasco, Körner's material includes three other forms which he (1937, p. 165, pl. 11, figs. 2, 3) describes provisionally under the collective name "Formenkreis der *Spiriferina kössenensis* Zugmayer." No figure is given of yet another form, which he describes (1937, p. 167) under the name "*Spiriferina* cf. *canavarica* Tommasi"; but, to judge by his description, it might well also be a *Spondylospira*. Should this be the case, this form would probably have to be renamed. Perhaps the fragment of a dorsal valve, named by Körner (1937, p. 170, pl. 11, fig. 9) "*Spiriferina* (?) sp. ind." and compared by him with his *Spiriferina acrotamboensis*, belongs to *Spondylospira*.

This genus may have persisted in the Peruvian area into Liassic times; *Spiriferina steinmanni* Tilmann (1917, p. 683, pl. 25, fig. 11) and the same author's *Spiriferina* sp. (1917, p. 689, pl. 25) from the Middle Liassic of three localities south of Cerro de Pasco seem to exhibit both external and internal characters of *Spondylospira*.

In addition to these Peruvian representatives of *Spondylospira*, the true "*Spiriferina*" *kössenensis* Zugmayer (1880, p. 28, pl. 3, figs. 2, 3, 13) from the Upper Triassic (Rhaetic) of the northern calcareous Alps of Austria appears, to judge by its perpendicularly striated area and its internal skeleton, also to be referable to Cooper's new genus.

Thus, *Spondylospira* Cooper seems to include not only the genotype *S. reesidei* Cooper (1942, p. 232) and the two North American species referred to it by Cooper himself, viz., "*Spiriferina*" *alia* Hall and Whitfield (1877, p. 281, pl. 6, fig. 17) from the Triassic of Nevada and "*Cyrtina*" *lewesensis* Lees (1934, p. 35, pl. 1, figs. 14–16) from the Upper Triassic (Carnic-Noric) of the Laberge Area, Yukon, Canada, but also the following forms: "*Spiriferina*" *kössenensis* Zugmayer from the Upper Triassic (Rhaetic) of the northern calcareous Alps of Austria; the three forms compared to Zugmayer's species by Körner under the collective name "Formenkreis der *Spiriferina kössenensis* Zugmayer," *S. acrotamboensis* (Körner), *S. robusta* (Körner), and perhaps also "*Spiriferina* cf. *canavarica* Tommasi" and "*Spiriferina* (?) sp. ind.," all seven of them from Triassic (Cassian-Raibl) strata of the Nevado de Acrotambo, northern Peru, *S. acrotamboensis* (Körner) and *S. robusta* (Körner) occurring also in apparently contemporary beds of the Cerro de Pasco area of central Peru. Possibly also "*Spiriferina*" *steinmanni* Tilmann and "*Spiriferina* sp." Tilmann, both from the Middle Liassic of the same area, are to be referred to this genus.

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CHECK LIST OF THE FOSSIL REPTILES OF NEW JERSEY

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IN THE last half of the nineteenth century southern New Jersey was considered the best collecting grounds for fossil reptiles. It was from the New Jersey marl pits that Leidy and Cope obtained many of their specimens. Marl pits were a familiar sight, and every farmer had one on his farm. Cope and other paleontologists of his time made it a point to stand in well with the farmers and marl pit operators and thus received much valuable material. Today all but three marl pits have been abandoned, and of the three only two are being worked to capacity. The result is that few vertebrate fossils are being found in New Jersey at present.

The following is an attempt to list all species found in New Jersey, together with the location of the type specimen.

SPECIES OF FOSSIL REPTILES FROM NEW JERSEY

Class REPTILIA

Order COTYLOSAURIA

Family PANYTYLIDAE

Hypsognathus fenneri GILMORE (1928, pp. 1–8). Upper Triassic (Brunswick shale): Clifton, Passaic County. Type: U. S. Nat. Mus. 11643.

Order CHELONIA

Family BOTHREMYDIDAE

Bothremys cooki LEIDY (1865, pp. 110–120). Eocene: Barnsboro, Gloucester County. Type: Geology Museum, Rutgers Univ.

Taphrosphys leslianus COPE (1869–70, pp. 159, 166). Eocene: Hornerstown, Monmouth County. Type: Am. Mus. Nat. History 1467.

Taphrosphys longinuchus COPE (1869–70, p. 159). Eocene: Medford, Burlington County. Type: Am. Mus. Nat. History 1125.

Taphrosphys molops COPE (1869–70, pp. 158–159). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1472.

Taphrosphys nodosus COPE (1869–70, pp. 159, 167). Eocene: Hornerstown, Monmouth County. Type: Am. Mus. Nat. History 1480.

Taphrosphys strenuus COPE (1869–70, p. 166b). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1126.

Taphrosphys sulcatus (LEIDY) (1856, p. 303). (*Platemys.*) Eocene: Tinton Falls, Monmouth County. Type: Geology Museum, Rutgers Univ.

Amblypeza entallis HAY (1908, p. 122). Eocene?: type locality unknown. Type: New Jersey Geol. Survey.

Family THALASSEMYDIDAE

Osteopygis borealis (WIELAND) (1904, p. 129). (*Propleura.*) Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus. 778.

Osteopygis chelydrinus COPE (1868, p. 147). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1131.

Osteopygis emarginatus COPE (1868, p. 147). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1344.

Osteopygis erosus COPE (1875, p. 258). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1130.

Osteopygis gibbi WIELAND (1904, p. 118). Eocene: Barnsboro, Gloucester County. Type: Yale Univ., Peabody Mus. 783.

Osteopygis platylomus COPE (1869a, p. 89). Eocene: Pemberton, Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Osteopygis robustus HAY (1908, p. 134). Eocene: Birmingham, Burlington County. Type: Am. Mus. Nat. History 2360.

Osteopygis sopitus (LEIDY) (1865, pp. 104, 119). (*Chelone.*) Eocene: Tinton Falls, Monmouth County. Type: Geology Museum, Rutgers Univ.

Catapleura ponderosa COPE (1871, p. 46). Eocene: Hornerstown, Monmouth County. Type: Am. Mus. Nat. History 1475.

Catapleura repanda (COPE) (1868, p. 147). (*Osteopygis.*) Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Lytoloma angusta COPE (1869–70, p. 145). Eocene: Birmingham, Burlington County. Type: Am. Mus. Nat. History 1133.

Lytoloma jeanesii COPE (1869–70, p. 145). Eocene: Barnsboro, Gloucester County. Type: missing.

Lytoloma wielandi HAY (1908, p. 157). Eocene: Hornerstown, Monmouth County. Yale Univ., Peabody Mus.

Erquilinnesia molaria HAY (1908, p. 160). Eocene: Birmingham, Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Rhetechelys platyops (COPE) (1867, p. 41) .(*Euclastes.*) Eocene: Hurffville, Camden County. Type: Acad. Nat. Sci. Philaddlphia.

Atlantochelys mortoni AGASSIZ in LEIDY (1865, p. 43). Eocene: Burlington County. Type: missing.

Peritresius ornatus (LEIDY) (1865, p. 303). (*Chelone.*) Eocene: Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Lembonax insularis COPE (1872, p. 16). Eocene: Vincentown, Burlington County. Type: Am. Mus. Nat. History 2347.

Lembonax polemicus COPE (1869–70, p. 168). Eocene: Farmingdale, Monmouth County. Type: Am. Mus. Nat. History 1134.

Lembonax propylaeus COPE (1872, p. 15). Eocene: Farmingdale, Monmouth County. Type: Am. Mus. Nat. History 1310.

Procolpochelys grandaeva (LEIDY) (1851, p. 329). (*Chelone.*) Miocene: Salem County. Type: Acad. Nat. Sci. Philadelphia.

Chelonia parvilecta COPE (1869–70, p. 155). Eocene: Squankum, Monmouth County. Type: Am. Mus. Nat. History 1318.

Adocus agilis COPE (1868, p. 235). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1135.

Adocus beatus (LEIDY) (1865, pp. 107, 119.) (*Emys.*) Eocene: Mullica Hill, Gloucester County. Type: Acad. Nat. Sci. Philadelphia.

Adocus lacer HAY (1908, p. 241). Upper Cretaceous (Eocene?): location not known. Type: Am. Mus. Nat. History 1350.

Adocus pravus (LEIDY) (1856, p. 303). (*Emys.*) Eocene: Tinton Falls, Monmouth County. Type: Geology Museum, Rutgers Univ.

Adocus punctatus MARSH (1890, p. 178). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Adocus syntheticus COPE (1870, p. 515). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History 1466.

Agomphus firmus (LEIDY) (1856, p. 303). (*Emys.*) Eocene: Tinton Falls, Monmouth County. Type: Geology Museum, Rutgers Univ.

Agomphus masculinus WIELAND (1905, p. 437). Eocene: Barnsboro, Gloucester County. Type: Yale Univ., Peabody Mus.

Agomphus pectoralis (COPE) (1868, p. 236). (*Pleurosternum.*) Eocene: Medford, Burlington County. Type: Am. Mus. Nat. History 1478.

Agomphus petrosus (COPE) (1868, p. 236). (*Adocus.*) Eocene: Gloucester, Camden County. Type: Am. Mus. Nat. History 1482.

Agomphus tardus WIELAND (1905, p. 430). Eocene: Birmingham, Burlington County. Type: Yale Univ., Peabody Mus. 774.

Agomphus turgidus (COPE) (1869–70, pp. 125, 127). (*Emys.*) Eocene: Mount Holly, Burlington County. Am. Mus. Nat. History 1481.

Zygoramma microglypha COPE (1871, p. 44). Eocene: Birmingham, Burlington County. Type: Am. Mus. Nat. History 6129.

Zygoramma striatula COPE (1870, p. 550). Eocene: Pemberton, Burlington County. Type: Am. Mus. Nat. History 2358.

Homorophus insuetus COPE (1870, p. 552). Eocene: Pemberton, Burlington County. Type: missing.

Family TRIONYCHIDAE

Amyda halophila (COPE) (1869b, p. 12). (*Trionyx.*) Cretaceous: Camden County. Type: Am. Mus. Nat. History 1476.

Amyda lima (COPE) (1869b, p. 12). (*Trionyx.*) Miocene: Cumberland County. Type: Am. Mus. Nat. History.

Amyda prisca (LEIDY) (1851, p. 329). (*Trionyx.*) Cretaceous; Monmouth County. Type: Geology Museum, Rutgers Univ.

Order SAUROPTERYGIA
Family PLEISIOSAURIDAE

Plesiosaurus brevifemur COPE (1875, p. 256). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Elasmosaurus orientalis COPE (1869–70, p. 55). Eocene: Swedesboro, Gloucester County. Type: Am. Mus. Nat. History.

Family PLIOSAURIDAE

Cimoliasaurus magnus LEIDY (1851, p. 325; 1854, p. 72). Eocene: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Discosaurus planior LEIDY (1870, p. 22). Eocene: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Discosaurus vetustus LEIDY (1851), p. 326). Eocene: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Taphrosaurus lockwoodi (COPE) (1869–70, p. 40). (*Plesiosaurus.*) Eocene: Matawan, Monmouth County. Type: Am. Mus. Nat. History.

Order CROCODILIA
Family PHOLIDOSAURIDAE

Hyposaurus ferox MARSH (1871, p. 104). Eocene: Birmingham, Burlington County. Type: Am. Mus. Nat. History 2198.

Hyposaurus natator TROXELL (1925, p. 496). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus. 985.

Hyposaurus natator owenii TROXELL (1925, p. 505). Eocene: Barnsboro, Gloucester County. Type: Yale Univ., Peabody Mus. 753.

Hyposaurus rogersii OWEN (1849, p. 382). Eocene: Birmingham, Burlington County. Type: missing.

Gavialis fraterculus (COPE) (1869–70, p. 82). (*Hyposaurus.*) Eocene: Birmingham, Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Gavialis minor MARSH (1870, p. 97). Eocene: Shark River, Monmouth County. Type: Yale Univ., Peabody Mus.

Thoracosaurus basifissus (OWEN) (1849, p. 380). (*Crocodilus.*) Eocene: Vincentown, Burlington County. Type:missing.

Thoracosaurus basitruncatus (OWEN) (1849, p. 380). (*Crocodilus.*) Eocene: New Jersey. Type: missing.

Thoracosaurus brevispinus COPE (1867, p. 39). Eocene: Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Thoracosaurus cordatus (COPE) (1869–70, p. 73). (*Holops.*) Eocene: New Jersey. Type: Am. Mus. Nat. History.

Thoracosaurus glyptodon COPE (1869–70, p. 74). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Thoracosaurus meirsanus TROXELL (1925, p. 223). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus. 404.

Thoracosaurus mullicensis TROXELL (1925), p. 227). Eocene: Mullica Hill, Gloucester County. Type: Yale Univ., Peabody Mus. 283.

Thoracosaurus necesariensis (DEKAY) (1833, p. 156). (*Gavial.*) Eocene: Vincentown, Burlington County. Type: missing.

Thoracosaurus obscurus (LEIDY) (1865, p. 115). (*Crocodilus.*) Eocene: Barnsboro, Gloucester County. Type: Geology Museum, Rutgers Univ.

Thoracosaurus pneumaticus (COPE) (1872, p. 11). (*Holops.*) Eocene: Harrisonville, Gloucester County. Type: Am. Mus. Nat. History.

Crocodilus sericodon (COPE) (1867, p. 143). (*Thecachampsa.*) Miocene: New Jersey. Type: Am. Mus. Nat. History.

Crocodilus serratus (COPE) (1872, p. 171). (*Thecachampsa.*) Eocene: Farmingdale, Monmouth County. Type: Am. Mus. Nat. History.

Crocodilus squankensis (MARSH) (1869, p. 391). (*Thecachampsa.*) Eocene: Squankum, Monmouth County. Type: Yale Univ., Peabody Mus.

Bottosaurus harlani (MEYER) (1832, p. 108). (*Crocodilus.*) Eocene: Birmingham, Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Bottosarusu tuberculatus COPE (1869–70, p. 230). Eocene: Tinton Falls, Monmouth County. Type: Am. Mus. Nat. History.

Order DINOSAURIA
Family DINODONTIDAE

Clepsysaurus pennsylvanicus LEA (1851, p. 185). Triassic: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Dryptosaurus aquilunguis (COPE) (1869–70, p. 100). (*Laelaps.*) Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Family ORNITHOMIMIDAE

Coelosaurus antiquus LEIDY (1865, p. 119). Eocene: Monmouth County. Type: Acad. Nat. Sci. Philadelphia.

Family HADROSAURIDAE

Hadrosaurus cavatus COPE (1871, p. 50). Eocene: New Jersey. Type: Am. Mus. Nat. History.

Hadrosaurus foulkii LEIDY (1858, p. 218). Eocene: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Hadrosaurus minor MARSH (1870, p. 2). Eocene: Barnsboro, Gloucester County. Type: Yale Univ., Peabody Mus.

Ornitholarsus immanis COPE (1869–70, p. 121). Eocene: clay bank on shore of Raritan Bay, Monmouth County. Type: Am. Mus. Nat. History.

Pneumatoarthrus peloreus COPE (1870, p. 446). Eocene: Monmouth County. Type: Am. Mus. Nat. History.

Order SQUAMATA
Family TYLOSAURIDAE

Tylosaurus laticaudus MARSH (1870, p. 2). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Tylosaurus rapax HAY (1902, p. 473). New name for *Liodon validus* COPE (1869–70, p. 205). Eocene: Medford, Burlington County. Type: Am. Mus. Nat. History.

Tylosaurus sectorius (COPE) (1871, p. 41). (*Liodon.*) Eocene: Birmingham, Burlington County. Type. Am. Mus. Nat. History.

Macrosaurus mitchillii (DEKAY, 1830, p. 140). (*Geosaurus.*) Eocene: Monmouth County. Type: Am. Mus. Nat. History.

Family MOSASAURIDAE

Mosasaurus copeanus MARSH (1869, p. 393). Eocene: Marlborough, Monmouth County. Type: Yale Univ., Peabody Mus.

Mosasaurus dekayi BRONN (1838). Eocene: Holmdel, Monmouth County. Type: missing.

Mosasaurus depressus COPE (1869–70, p. 196). Eocene: Birmingham, Burlington County. Type: Acad. Nat. Sci. Philadelphia.

Mosasaurus fulciatus COPE (1869–70, p. 194). Eocene: Monmouth County. Type: Am. Mus. Nat. History.

Mosasaurus maximus COPE (1869c, p. 262). Eocene: Monmouth County. Type: Am. Mus. Nat. History.

Mosasaurus mierssii MARSH (1869, p. 395). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Mosasaurus oarthrus COPE (1869–70, p. 196). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Mosasaurus princeps MARSH (1869, p. 392). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Clidastes conodon COPE (1881, p. 587). Eocene: Freehold, Monmouth County. Type: Geology Museum, Rutgers Univ.

Clidastes iguanavus COPE (1868, p. 233). Eocene: Swedesboro, Gloucester County. Type: Am. Mus. Nat. History.

Family PLATECARPIDAE

Nectoportheus validus COPE (1868, p. 181). Eocene: Barnsboro, Gloucester County. Type: Am. Mus. Nat. History.

Batosaurus fraternus MARSH (1869, p. 397). Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Batosaurus platyspondylus (MARSH) (1869, p. 395). (*Halisaurus.*) Eocene: Hornerstown, Monmouth County. Type: Yale Univ., Peabody Mus.

Polygonodon vetus LEIDY (1856, p. 221). Eocene: New Jersey. Type: Acad. Nat. Sci. Philadelphia.

Order SERPENTES
Family PALAEOPHIDAE

Palaeophis grandis (MARSH) (1869, p. 397). (*Dinophis.*) Eocene: Shark River, Monmouth County. Type: Yale Univ., Peabody Mus.

Palaeophis halidanus COPE (1868, p. 235). Eocene: Squankum, Monmouth County. Type: Am. Mus. Nat. History.

Palaeophis littoralis COPE (1868, p. 234). Eocene: Squankum, Monmouth County. Type: Am. Mus. Nat. History.

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PALEONTOLOGICAL NOTES

"UPPER ALBIAN AMMONITE FROM . . . NEW MEXICO" A TURONIAN PRIONOCYCLUS

OTTO HAAS
The American Museum of Natural History, New York, N. Y.

Dr. John B. Reeside, Jr., kindly suggested that the fragment I described and figured (Amer. Mus. Novitates No. 1223, 1943) as "*Pervinquieria* cf. *romeri* Haas" might belong to a large adult of *Prionocyclus* instead. A detailed study of "Intraspecific variation in, and ontogeny of, *Prionotropis woollgari* and *Prionocyclus wyomingensis*" which I made since fully confirms this assumption. Since publication of the latter paper has been unexpectedly delayed, the present rectification is published separately.

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MARTIN, HANDELL T. Died Jan. 15, 1931.
MATTHEW, GEO. F. Died Apr. 17, 1923.
*MATTHEW, W. D. Died Sept. 24, 1930.
MEACHEM, R. P. Died Feb. 13, 1934.
MESLER, RECTOR D. Died Feb. 25, 1944.
MOODY, W. L. Died Oct. 9, 1920.
NOBLE, G. KINGSLEY. Died Dec. 9, 1940.
*NOÉ, ADOLF C. Died Apr. 10, 1939.
NOMLAND, JORGEN O. Died May 7, 1943.
*PARKS, WM. A. Died Oct. 3, 1936.
PATTEN, WM. Died Oct. 23, 1932.
*PENHALLOW, DAVID P. Died Oct. 20, 1910.
PETERSON, O. A. Died Nov. 13, 1933.
*PROSSER, C. S. Died Sept. 11, 1916.
*RATHBUN, MARY JANE. Died Apr. 4, 1943.
*RESSER, CHARLES E. Died Sept. 18, 1943.
ROUNDY, PAUL V. Died June 21, 1937.
*SCHUCHERT, CHARLES. Died Nov. 20, 1942.
*SEELY, HENRY M. Died May 4, 1917.
*SINCLAIR, W. J. Died Mar. 25, 1935.

SLOCUM, ARTHUR W. Died Nov. 20, 1937.
*SPRINGER, FRANK. Died Sept. 22, 1927.
TEGLAND, NELLIE M. Died Dec. 1930.
TELLER, EDGAR E. Died July 19, 1923.
*THOMAS, A. O. Died Jan. 13, 1931.
TIEJE, ARTHUR J. Died Jan. 25, 1944.
*TILTON, J. L. Died Nov. 17, 1930.
TWITCHELL, G. B. Died Apr. 28, 1933.
*TWITCHELL, M. W. Died Apr. 8, 1927.
ULRICH, EDWARD O. Died Feb. 23, 1944.
*VAN INGEN, GILBERT. Died July 7, 1925.
*VODGES, ANTHONY W. Died Feb. 8, 1923.
*WALCOTT, CHARLES D. Died Feb. 9, 1927.
WARING, CHARLES A. Died Nov. 5, 1918.
WARNER, WILLIAM C. Died Sept. 29, 1941.
WEINZIERL, MRS. J. F. Died Sept. 28, 1928.
*WELLER, STUART. Died Aug. 5, 1927.
*WHITE, DAVID. Died Feb. 7, 1935.
*WHITFIELD, R. P. Died Apr. 6, 1910.
*WILLIAMS, HENRY S. Died July 31, 1918.
WILLISTON, S. W. Died Aug. 30, 1918.
WILSON, HERRICK E. Died Jan. 24, 1925.
WHITTAKER, EDW. Died Sept. 14, 1924.

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In accordance with the provisions of Chapter IV, Section 1, of the By-Laws, the Council of The Paleontological Society announces the following nominations for offices in the Society for 1945:

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